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INPUT-OUTPUT ANALYSIS OF THE ALBERTA ECONOMY

by

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A THESIS

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ABSTRACT

The structural interdependence of an economy must be examined to properly assess the importance of individual sectors to the economy. One method of depicting the interaction between sectors of the economy is through the preparation of an input-output model.

This study presents a detailed analysis of the stages of construction of a model and culminates with the preparation of a thirty-nine by forty input-output model for the Province of Alberta. The textual material emphasises the analytical applications of the model using an aggregated five by five matrix. The aggregated model is used to calculate some measures of interaction between producing sectors of an economy, and to show the importance of certain sectors to the economy.

The model is particularly constructed to analyze the requirements of water resources in the economy, but is also useful in estimating the total direct and indirect requirements of any primary resource.

The appendix includes some details on the estimations made for each sector and states the more important sources of information.

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CHAPTER I

INTRODUCTION

I. PURPOSES OF THE STUDY

The Province of Alberta is in a state of rapid economic growth. Efforts to understand and guide this growth are being made by leaders in government and business. Civic departments are also being organized by many municipalities to attract new and varied industry and to promote further economic development. The complex structure of the Alberta economy makes it difficult to formulate rational programs of action and to estimate the effects of alternative courses of action.[1]

Difficulties in analyzing these and other problems arise because the many and varied agricultural, manufacturing and service industries comprising Alberta's economic structure are each dependent on the functioning of the other -- either directly, or indirectly, through a chain of direct dependence. Although an individual industry might be small in relation to the total economy, the reverberations of an action by or

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[1] This can be shown by the bold political moves made by urban and provincial governments to attract all forms of industry, but no attempts are made to rationalize the desirability of the industry nor to evaluate the indirect benefits attributable to various industries.

on that industry may be felt throughout the economy and the indirect effects of this action might easily be larger than the initial direct effects.

The economist interested in attacking these difficulties has many alternative research procedures to choose from. However, most procedures do not specifically consider the entire economy as an interrelated unit -- and those that do, allow only qualitative estimates of these relationships.

This study discusses and uses one research approach -- interindustry analysis -- that allows quantitative estimates of the interrelationships of a complete economy, and when applied to the Alberta economy, provides a framework for measuring the impact of alternative public and private investment decisions. The specific analytical tool to be used is the Leontief system of Input-Output Analysis. The values of goods and services of every industry are classified and arranged in such a manner that the sectors from which they are an output and to which they are an input are easily apparent. Subsequently, using rather simple mathematical transformations, coefficients are derived that give quantitative insights into the operations of the economy and enable us to investigate and analyze the effects of one industry on another.

The input-output framework provides direct, plus indirect requirements to meet projected final demands and in this way gives a more accurate measure of total requirements of scarce resources as well as indicating where these resources can be most beneficial to certain types of economic development.

II. OBJECTIVES OF THE STUDY

The general objective of this study is to quantify and analyze the structure of the Alberta economy so as to identify interactions among economic sectors within the province. The analytical model may be applied to assist in the allocation of scarce resources for their optimal division between beneficial uses once given the economic goals.

Emphasis is focused on the possible utilization of the model to allocate water resources and indicate the indirect dependence of the economy on water.

The shortage of time has made it necessary to limit the study to the construction of an input-output model for the Alberta economy such that it lends itself to evaluating the water resource requirements of the Province, and to indicate other uses for the model to suggest areas in which further research should be conducted. The model is static in character deriving its results from the analysis of the operations of the economy for the year 1962.

CHAPTER II

PRINCIPLES OF INPUT-OUTPUT ANALYSIS

One of the most interesting developments in the field of economics in recent years is the model of industrial interdependence known as input-output analysis. To the astute economist the theory of input-output analysis has at least three important aspects:

1. It is of interest to the economic theorist because it provides the simplest expression of Walrasian general equilibrium conditions. Its form is so simple that it holds out the hope of empirical statistical measurement.
2. Input-output analysis is of interest to the national income economist because it provides a more detailed and meaningful breakdown of the macroaggregates and money flows.
3. The theory of input-output can be regarded as a peculiarly simple form of linear programming.

When used to describe the Alberta economy, input-output analysis provides a concise statement of the intra-industry transactions, and as well the interindustry transactions. It is the interindustry transactions that are usually neglected in most examples of macroeconomic research.

I. HISTORICAL BACKGROUND

From a historical point of view, the first step toward a form of general equilibrium analysis, from which the input-output method stems, is customarily traced to the famous French economist Francois Quesnay. About 200 years ago, Quesnay published his Tableau Economique in which the concept of compartmentalized productive activities was perhaps first advanced.[2] These ideas are said to have influenced Adam Smith in his great work, The Wealth of Nations published in 1776. However, the basic idea of a general equilibrium model was not again emphasized until another frenchman, Leon Walras published Elements D'Economie Politique Pure in 1874.[3] At that time Walras was professor of economics at the Academy of Lausanne. His approach was highly abstract and dealt with a mathematical model based on the interdependence of the productive sectors of the economy.

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[2] Quesnay's tableau economique had productive industry (agriculture), service industries, and final demand presented in a form strongly suggestive of present day input-output models. Phillips, A. "The Tableau Economique as a Simple Leontief Model," Quarterly Journal of Economics, Vol. 69, February 1955; Quesnay, Francois, Tableau Economique, first printed in 1758, reproduced in facsimile for the British Economic Association, London, England, 1894.

[3] Walras, Leon, Elements of Pure Economics, Translated by W. Jaffe, Homewood, Illinois, Richard Irwin Inc., 1954.

It was not until the mid 1930's that Professor Wassily Leontief of Harvard University developed the first applied model of this type based on empirical data available for the economy of the United States. Leontief began work on the construction of the first input-output table for the United States in 1931. He spent five years developing his tables and applying the mathematics. His first study, published in The Review of Economic Statistics in August 1936, presented a forty-two by forty-two input-output table which illustrated the quantitative input and output relations for the economic system of the United States in 1919. Leontief wrote "the statistical study presented.......may be best defined as an attempt to construct, on the basis of available data, a Tableau Economique of the United States for the year 1919.[4]"

A more complete investigation of the subject was published in 1941 under the title The Structure of the American Economy, 1919-1939.[5] It included a twenty-one by twenty-one input-output table and laid the groundwork for the practical application of his theory.

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[4] Leontief, W.W., "Quantitative Input and Output Relations in the Economic System of the United States," The Review of Economic Statistics, Vol. 18 (August, 1936), P. 105.

[5] Leontief, W.W., The Structure of the American Economy 1919-1939, 2nd ed., New York, Oxford University Press, 1951.

Research in input-output economics has grown rapidly since the 1930's and the statistical analysis of inter-industry relations have now been undertaken in more than twenty countries to complement the more traditional forms of economic studies. Of most interest to the Canadian researcher is the forty-two sector input-output study of Canada for the year 1949, which was completed in 1956.[6] Its initial purpose was to improve the systems of national accounts and other government statistics. The study was done solely to provide a detailed description of the economy rather than as the basis for an econometric model.

II. THEORETICAL STRUCTURE

From the technical point of view, the basis of the Leontief analytical system is the input-output model itself. The table is so termed because it shows the manner in which the output of each industry is distributed among the other industries as inputs for further processing. It also depicts the output going into final consumption in various forms. The preparation of an input-output table for use in emperical work takes place in various stages. The researcher must decide

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[6] Dominion Bureau of Statistics, The Interindustry Flow of Goods and Services Canada, 1949, Ottawa, The Queens Printer, 1956.

what size of table is most appropriate and the manner in which producing industries can be aggregated or added together into producing sectors, since both size and aggregation may vary depending upon the uses the table is intended to serve.

In economic analysis the basic business unit is a firm and all firms producing similar goods or using similar inputs are regarded as comprising an industry. The basic problem facing the analyst is that of reducing the number of individual industries existing in the economy (which may number thousands) to a workable number (preferably thirty to forty) by aggregating sectors with similar input and output structures.

When the size and sectoral composition of the table is decided upon, the matrix of interindustry transactions in dollar values is prepared. This so called transactions matrix is converted into a technical input coefficient matrix showing direct industry purchases per unit of output. The technical coefficient of production is defined in economic theory as the amount of the output of industry i required to produce one unit of output of industry j. This definition is in conformity with the physical aspect of production. Within the context of input-output analysis, however, the technical coefficient really represents the flow of goods from one local industry to produce a unit of output of another local industry.

The difference in treatment lies in the fact that in input-output analysis the technical coefficients need not represent the total requirements of one input because such things as imports may be included in the output of the local industry.

From the technical coefficient matrix one may derive the Leontief matrix and eventually the Leontief inverse matrix of interdependence coefficients.[7] The interdependence coefficients serve to explain the total direct *and* indirect requirements of each industry's output required to meet a given final demand. These coefficients are used to develop output multipliers for the whole economy.

To develop a precise definition of the interdependence coefficients and to express their relation with the technical coefficients, one may consider a set of constants (B_{ij} $(i=j=1..n)$ where B_{ij} reflects the sum of the direct and indirect inputs of commodity i required by the economic system in order to deliver one dollar of output of industry j to the final demand sector. These B_{ij} coefficients, it should be noted, are independent of any changes in the nature and composition of the final demand sector. They are merely a means of evaluating the impact of a change in the final demand sector

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[7] The mathematical construct of the derivation of the matrices is discussed in Appendix A.

upon the output structure of the region that is less cumbersome than a round by round iterative procedure of evaluation. For example, any increase in final demand for agricultural products necessitates not only an increase in the output of agricultural products but, in turn an increase in the outputs of other industries which supply inputs to the agricultural industry; and hence, indirectly an increase in regional income and employment.

The mechanical process of computing the secondary effects of changes in final demand is reduced to a bare minimum when the interdependence coefficients are calculated as a function of known technical coefficients. In this procedure of evaluation of the impact of final demand, the interdependence coefficients are necessarily treated as constants since they are based on the assumption of constancy of technical coefficients. As a result they are subject to the same limitation as the technical coefficients; that is, the trade flows relate to a single year -- 1962.

Digressing momentarily to consider Figure I, which introduces the notation to be followed hereafter, one may see the formal properties of the input-output accounting system.[8]

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[8] This is the notation used by Chenery and Clark. See Chenery, Hollis B. and Paul G. Clark, Interindustry Economics, New York, John Wiley and Sons Inc., 1959.

		PURCHASING SECTORS										
		INTERMEDIATE USE		FINAL DEMAND								
			Total Intermediate Use	Construction	Capital Formation	Government	Households	Exports	Total Final Use	Total Supply or Total Use	Imports	Domestic Production
PURCHASING SECTORS	1	$X_{1,1}$ .... $X_{1,34}$	W_1						Y_1	Z_1	M_1	X_1
	.	. QUADRANT II .	.			QUADRANT I			.	.	.	.
	34	$X_{34,1}$ .... $X_{34,34}$	W_{34}						Y_{34}	Z_{34}	M_{34}	X_{34}
TOTAL		U_1 .... U_{34}										
VALUE ADDED	35 . 40	QUADRANT III				QUADRANT IV						
TOTAL PRODUCTION		X_1 .... X_{34}	W						Y	Z		X

FIGURE 1

BASIC INTERINDUSTRY ACCOUNTING SYSTEM

The separation between intermediate and final use and between produced and primary inputs leads to four types of transactions, which are shown in the table and defined as follows:

Quadrant I --contains the final use of produced commodities and services broken down by the major type of use.

Quadrant II --comprises the main part of the interindustry accounts or the transactions matrix as it was called earlier. It contains the use of endogenous inputs or those that are produced within the economy. Each entry X_{ij} indicates the amount of commodity i used by sector j measured in constant prices. The total intermediate use of any commodity is given by W_{ij} and the total purchases from other sectors by a given sector is given by U_j.

Quadrant III --contains the use of inputs that are primary or exogenous to the economy in the sense that they are not produced within the system. (In a static model the use of existing capital, imports, land, and labor as well as the indirect taxes when the output is valued at market prices are considered primary.) The total payment for primary factors by each sector, therefore, corresponds approximately to the value added in production, being the difference between the value of output and the cost of inputs produced outside the given establishment.

Quadrant IV --contains the direct input of primary factors to final use, of which main examples are government employment and domestic service.

The formal structure of input-output analysis can best be expressed in symbols. The basic elements are defined as follows:

X_i = total production of commodity i.

Y_i = total final demand for commodity i.

Z_i = total supply or total use of commodity i.

M_i = imports of commodity i by all sectors of the economy.

W_i = total intermediate or interindustry use of commodity i.

X_{ij} = use of commodity i by sector j.

U_j = total intermediate inputs purchased by sector j.

V_j = total purchases of primary inputs by sector j.

These basic concepts lead to two balance equations - one representing the row entries - the other representing the column entries. The first equation applies to the rows of Figure 1. It states that the total supply of each commodity equals the total demand for each commodity.

$$(1) \qquad Z_i = M_i + X_i = \sum_j X_{ij} + Y_i = W_i + Y_i$$

The second equation applies to the columns of Figure 1. It states that the total value of production of each sector is equal to the total value of inputs purchased from other intermediate sectors plus the value added in the form of primary inputs by the sector.

$$(2) \qquad X_i = X_{ij} + V_i = U_j + V_j$$

These equations provide the basic formulation for the interindustry accounting system and as such supply the theory to be followed throughout the study.

III. UNDERLYING ASSUMPTIONS

The normal method of preparing an input-output table is from the dollar values of all industry purchases and sales given in census data. For a particular industry the basic assumption is that the dollar values can be taken as a quantitative measure of physical purchases in real terms and that the long-run relative prices will not grossly distort the quantitative pattern of purchases per unit of output.

Further, input-output analysis can be carried out by formulating the model in two distinct ways - "the Leontief Open System" or simply the "Open System" and the "Walras-Leontief Closed System" or simply the "Closed System".[9] Both systems have been criticized for assuming the constancy of technical coefficients, that is, that the amount of a particular local input used in producing a unit of output remains fixed. Problems connected with capital formation are usually ignored in the transactions matrix because of the difficulties of securing reliable data and because the economic system is explained purely in terms of static conditions without explicitly incorporating changes in

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[9] For a discussion of the differences between the two systems, see Allen, R.G.D., Mathematical Economics 2nd ed., New York, St. Martin's Press Inc., 1959, Pp. 348-349 and 358-359.

technology brought about by internal economies of scale, external economies due to urbanization, or as mentioned earlier, changes in relative prices of commodities. The main criticism leveled against the application of input-output analysis is the inability to forsee technological change. This makes it difficult to adopt variable technical or trade coefficients, especially when capital investment is included as an endogenous sector.[10] This same criticism seems to be applicable to any other social science technique which, of necessity, has to proceed in the face of uncertainty regarding future technological changes. Any projections made of the output structure of a dynamic economy must therefore be subject to these limitations. When dealing with a regional economy such as that of the Province of Alberta this limitation becomes more pronounced since any change in the type of products produced locally affects the validity of the transactions matrix.

Controversy on the theoretical points on which the Leontief System rests has become widespread. Thus far empirical evidence has neither proved nor disproved the validity of the technique. Until such time as the actual results may be compared to the projected results of an input-output model, the conclusion is that the model gives as good

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[10] To overcome this in the Alberta Model capital formation has been included as an exogenous sector.

or better predictive results than other comparable techniques.[11]

The foregoing theoretical framework has given the reader a brief introduction to the use and preparation of an input-output model. With this basic theoretical framework in hand, one may now proceed to investigate some of the specific definitions and classifications to be used in the construction of the Alberta Model and lay down the guidelines to be followed.

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[11] The argument can best be summed up by the following statement made by C. Christ.

" The preceding appraisals of input-output analysis from theoretical and emperical points of view are clearly inconclusive. The theoretical appraisal cannot be conclusive by itself because the question is one of usefulness in the real world, and the emperical appraisal cannot be conclusive until more evidence is known. I plead for the preparation of data on the final bill of goods and the total outputs of industries for several different years, so that it can be seen how well the 1947 matrix (and any future one) works, not for just one year, but for several years....... The input-output technique is certainly better than no technique. What are the alternatives? Clearly, a real general equilibrium system would be the best, barring cost, but this is not a realistic alternative. Clearly, linear programming would be better than input-output if the relevant data were developed to the same degree, for it would have all the advantages of input-output analysis plus the added advantage of being able to deal automatically with substitution among inputs. It is not a practical alternative at present even though it may become one. I believe that input-output is the best technique now available for handling problems that require a picture of the production function of the entire economy, and that its results can serve as first approximations from which to start making corrections where special information permits or experience demands."

See; Christ, C. Input-Output Analysis: An Appraisal, Conference on Research in Income and Wealth, Studies in Income and Wealth. Vol. 18, Princeton, Princeton University Press, 1955.Pp. 168-169.

CHAPTER III

THE ALBERTA MODEL

I. STATEMENT OF THE PROBLEM

The general purpose of this study is to measure the input-output relationships of the Province of Alberta with special emphasis on the utilization of the model for decision making purposes. The problem includes a detailed examination of the structural input relationships for the various industries or sectors within the area, how these industries are related to one another, and eventually how these interrelationships can be used for decision making purposes. The initial purpose of this study is to indicate how the model may be used to evaluate the allocation of scarce resources such as water.

The model is based on the year 1962 since this is the most recent year for which complete and published statistics are available.

II. SELECTION OF THE DATA

Ideal Requirements. Theoretically the most useful data for a study of this nature would include a complete and accurate estimate of material input, labor requirements, shipments, construction, inventories, taxes, and profits

of all industrial, governmental, trade, and service firms located in the Province of Alberta. With such complete data it would be possible to construct an input-output table which would reflect the interindustry flows with extreme accuracy. The available statistics obviously do not approach these hypothetical requirements.

The Sample Survey. After a preliminary analysis of the economy of the Province and consideration of the time period and costs involved, it was determined that interindustry flows could be shown adequately by using thirty-four endogenous sectors and five exogenous sectors for a total of thirty-nine sectors.

Although an attempt was made to aggregate industries that are homogeneous in both input structure and product type, other important considerations were:

1. The form of the secondary sources.
2. Available time and funds.
3. The stated objective of emphasizing water as an input.

The Standard Dominion Bureau of Statistics definition of industry classification was followed where possible, but some departures were necessary to facilitate the use of the model as a planning device. The methods used in the preparation of the transactions table are believed to be somewhat unique to input-output analysis. Direct sampling of information

provided by firms was used wherever possible to obtain input structures of the endogenous sectors. Additionally, the entries were arrived at by tracing the inputs purchased by each firm rather than tracing the sales of output by the firms as is frequently the case in input-output analysis.

A sample of 259 firms was used to arrive at the input structures reported in the transactions matrix. An effort was made to include both large and small firms in the sample except in cases where an oligopolistic structuring of the industry existed in which case only the large firms were used. The total output of the firms sampled constituted 87 per cent of the output of the Province, for the year 1962, for the sectors sampled. After the basic pattern of the area economy was established by the sample, some production totals were adjusted upward to equal the production totals for the Province.

In general it may be said that the transactions matrix was constructed from the "inside out" with certain adjustments made where published data indicated the need for them. In this way, interindustry flows and input coefficients were arrived at directly by sampling the producing sectors within the area. This technique differs from most others used in that other input-output studies often use national input coefficients combined with the area production totals to arrive

at interindustry flows. Only time will prove the accuracy of each method but it would seem clear that the method used in this study is superior, providing sector inputs have been adequately reflected by the sampled firms. In cases where doubtful results were derived, comparisons with the Canadian and or other models were made.

III. THE SELECTION OF SECTORS

Choice of Endogenous Sectors. One of the basic problems in input-output analysis is the choice of the endogenous sectors to be studied. This choice depends upon: (1) the costs and resources available for collection of detailed statistics on production of firms in the area, (2) the objectives of the study, (3) the time required for analysis of the basic data, and (4) the nature of the data available. Meaningful definitions of the sectors to be studied are of particular importance to the interindustry analysis of a small region such as a province.

The processing and manufacturing industries are classified on an establishment basis to conform to the standard Dominion Bureau of Statistics classification system. For the same reasons the service, trade and transportation sectors are classified on an activity basis. Agricultural sectors, partially because of data availability, are classified on a product basis. One advantage with this type of classification

is the comparative simplicity of valuing and distributing each sector's output. The mineral products and petroleum sectors are classified on a product basis.

Brief definitions of the endogenous sectors are found in Appendix B. The thirty-four sectors may be classified in five major groups as follows:

1. Agricultural Products -- (three sectors)
2. Mineral Products -- (two sectors)
3. Agricultural Processing -- (nine sectors)
4. Manufacturing -- (fifteen sectors)
5. Services -- (five sectors)

Choice of Exogenous or Final Demand Sectors. The levels and operations of final demand sectors are not explained by the input-output model itself. They are usually explained by exogenous factors that are determined outside the realm of influence of the producing industries of the region. The various components of final demand will vary with: (1) the problem at hand, (2) the region under study, (3) its stage of development, and (4) the cost of collecting information. For this particular study the accuracy of the entries in the final demand sectors was not of major concern. The interindustry model of intermediate transactions matrix is the tool that will be used when the model is used for predictive purposes. The inverse matrix

is all that will be used to apply the model to evaluate the allocation of water resources.[12]

A high degree of accuracy was required, however, to determine the import content of each input in the interindustry flow table. For this purpose a separate study was conducted to determine the actual amount of imported goods used by each sector in the production of their output.[13]

The final demand section of the model is not constructed symmetrically, i.e. each sector does not have both an input column and an output row. There are six rows of primary inputs and five columns of final demand. Since it was possible to separate capital inputs and corporate profits, an additional row was added. Definitions of the contents of each row and column entry are found in Appendix B.

IV. IMPORTANT DEFINITIONS

Selection of the Base Period. An input-output model is developed from data from one particular time period. All inputs and all outputs to and from each sector during this

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[12] See Chapter V ., page 58 for a complete explanation of the use of the inverse matrix for this purpose.

[13] The researcher used a Province of Alberta Bureau of Statistics study on imports and exports for the years 1946, 1954 and 1957 to arrive at estimations of imports and exports. This study was an analysis of the flow of goods and services across provincial borders as well as flows into and from other countries. Please see Appendix B, Page 89 for a more complete explanation of the study.

particular period are recorded in the "transactions" matrix. Each technical coefficient is thus developed from a single observation.

Although this study was begun in June, 1965, the year 1962 was the most recent with adequate published data. Provincial Bureau of Statistics publications and the information used for the sample were available only for 1962.

Definition of Output. The "gross domestic output" of each sector is the total value to the purchaser of all goods and services produced within the province, including those goods and services which are both produced and consumed within the same sector.

Definition of Input. The inputs used are valued "landed" at the purchaser's place of business. In this way, we assume that the producer pays all outgoing transportation on the goods he produces. One is thus talking about purchaser's prices when referring to input prices. This system was adopted since all information reported to the Provincial Bureau of Statistics follows this definition.

CHAPTER IV

RESULTS OF THE MODEL

The emperical results of the Alberta input-output models for 1962 are reported herein. Specific numbers are correlated to their mathematical counterparts, found in Chapter II and Appendix B, in order that facility in reading and interpreting the basic input-output table may be obtained. Certain economic implications and forecasts of these results are reported in Chapter V, but since the potential uses and implications of the models are varied, much is left to the reader's interpretation.

Because the basic tables are printed oversize, they are located in Appendix C. Thus, tables and text may be consulted in conjunction with each other.

I. THE FLOW TABLES

Table XXX (Appendix C) summarizes the interindustry flows in thousands of dollars of goods and services -- within, to, and from Alberta in 1962 by sector of origin and destination. Although each figure is presented as a single value estimate, they represent varying degrees of reliability. Reference to Appendix B of this study will provide a detailed discussion of estimation procedure and sources of information.

The interindustry flow tables closely resemble the formal input-output accounting system described in Figure 1, Chapter II. The flows to and from sectors of the Alberta economy are systematically arranged in the form of row and column entries described below.

The Row Entries

The entries in each row of Table XXX list, in purchasers' prices, the dollar value of each sector's output consumed by itself and each other sector of the economy. The row entries may best be described by the equation derived for the rows on page 13 of Chapter II, which states:

$$(1) \qquad Z_i = M_i + X_i = \sum_j X_{ij} + Y_i = W_i + Y_i$$

The equation simply states that the supply for each commodity equals the total demand for each commodity.

Using row 1 as an illustration, it is shown that the field crops sector consumed $21,016,000 worth of its own product $(X_{1,1})$, sold $75,558,000 of its output to the livestock industry $(X_{1,3})$, sold $35,090,000 of its output to the grain mill industry $(X_{1,9})$, sold $2,348,000 of its output to the alcoholic beverage industry $(X_{1,12})$, sold none of its output to the confectionary and sugar industry $(X_{1,13})$, sold $6,444,000 to the miscellaneous food industry $(X_{i,14})$, had an inventory accumulation of $13,124,000 $(X_{1,36})$, sold nothing to the

household sector ($X_{1,38}$), and exported $315,797,000 of its total output ($X_{1,39}$). The last column on the right lists the total gross domestic output (X_1) of the field crops sector as $469,378,000. All other rows of the model have analogous descriptions.

The Column Entries

Each column of Table XXX presents the input structure for a particular sector. The column entries may best be described by the equation derived for the columns on page 13, Chapter II:

$$X_j = X_{ij} + V_i = U_j + V_i \tag{2}$$

which states that the total production of each sector j is equal to the inputs purchased from other intermediate sectors plus the value added in the form of primary inputs by the sector.

The column entries may be illustrated by using some entries in column 5 as an example. The petroleum products sector purchased the following: $3,675,000 worth of goods from the mineral products sector ($X_{4,5}$), $2,073,000 of goods from the forestry and woodproducts sector ($X_{17,5}$), $77,947,000 of services from the transportation sector ($X_{31,5}$) and used $49,375,000 of imported inputs ($X_{39,5}$). The total output of the petroleum products sector is given as $582,594,000 ($X_5$).

The outlay of each sector may be similarily traced by examining its respective column entries in Table XXX.

The usefulness of Table XXX in its present form is limited to examining the underlying economic relationships which bind together the various segments of the provincial economy. In this form the table may be used by a particular manufacturer to trace the consumption patterns of his product or his competitor's products. He could possibly note the major users of his output and could estimate the results of changing economic factors on the sale of his product. However, input patterns are not too meaningful when given in gross terms. They can best be analyzed if they are normalized or translated into percentiles. The normalized input patterns are called input coefficients when presented in matrix form.

II. TECHNICAL INPUT COEFFICIENTS

Table XXXI (Appendix C) shows the direct purchases of each sector from every other sector, per dollar of output in 1962. Each cell entry (expressed in decimal form) is called a technical input coefficient and they indicate, in dollars, the amount of purchases made in 1962 from every industry listed in the rows, by the industry listed in the column in order to produce one dollar of output.

Technical coefficients are derived directly from the

matrix of interindustry flows. These coefficients denoted, as b_j, are derived from a single observation of intermediate input for a given output level as shown in equation (3).

$$b_j = \frac{X_{ij}}{X_j} \tag{3}$$

The entries for each column represent in effect, a linear technical production function for that sector. With the construction of this table, the assumptions which somewhat limit the validity of the model, i.e. constancy of input coefficients and freedom from errors in aggregation are made to permit use of the technical coefficient model to derive the inverse matrix.

Although purchases per dollar of output are relevant only for endogenous sectors, input coefficients have been included for final demand sectors 35 through 39, and primary input sectors 35 through 40. This was done to give a complete statistical description of 1962 purchases.

III. DISTRIBUTION OF OUTPUT

An additional requirement to facilitate descriptive applications of the model is a table expressing the distribution of output in decimal form. Table XXXII shows the technical output coefficients for each producing industry of the Alberta model.

The output coefficients are derived by dividing the entries in each row by the total output for each row. The distribution of output should prove to be of interest to the sales personnel of local industries in analyzing their output channels, and in searching for new customers. The table is not used in the derivation of the interdependence model, but is undeniably useful as a descriptive tool.

IV. TABLE OF INTERDEPENDENCE COEFFICIENTS

In the preceding discussion attention has been directed primarily toward the use and interpretation of the input-output model as a descriptive device. Interindustry economic analysis does not stop, however, with the construction and interpretation of a descriptive tool, for it is more than a structural study of interrelated economic transactions. This technique of analysis proves most useful as a problem solving device. The matrix of interdependence coefficients is a necessary item in any application of interindustry models.

The matrix of interdependence coefficients for Alberta, shown in Table XXXIII (Appendix C), was derived from the matrix of technical coefficients given in Table XXXI. The unique feature of this model is the summarization of direct plus indirect flows for the Province of Alberta in the year 1962. Each coefficient shows the direct plus indirect requirements

of each row sector per dollar of output delivered to final demand by the column sector.

At this point it should be noted that the direct relationships shown in Table XXXI reflect direct production requirements necessary to support a change of one dollar in the production of output regardless of whether it is used by the intermediate sectors or goes directly to final demand. The interdependence coefficients, on the other hand, reflect both direct and indirect production requirements necessary to support an additional one dollar change in final demand for the products and services of the producing sector. This distinction should be borne in mind when attempts are made to compare technical coefficients and interdependence coefficients. Methods of direct comparison of the coefficients will be discussed in detail in section V of Chapter V of this study.

V. SUMMARY

This chapter has presented a simplified interpretation of the various models constructed for the Alberta economy for 1962. The technical coefficients given in the matrix of Table XXXI (Appendix C), and the interdependence coefficients given in the matrix of Table XXXIII (Appendix C) can be used in a variety of ways to discuss the relative importance of indirect to direct effects of changes in final demand for the goods and

services produced in Alberta. As well, the interaction between sectors may be analyzed. The tables described in this chapter have been so constructed to facilitate these various analytical uses.

The various sections of Chapter V will describe, using an aggregated model, the numerous measures that may be computed using the interindustry models.

CHAPTER V

APPLICATION OF INPUT-OUTPUT RESULTS

I. INTRODUCTION

The direct and indirect requirements as reflected in the matrix of interdependence coefficients may be applied in a variety of ways to study the effects of growth on the local economy. The most desirable technique of analysis would be the calculation of the various measures (required to study the effects of growth) using the thirty-nine by forty sector interindustry model for Alberta. The short period of time available for this study makes it impossible to apply the complete Alberta model as desired. In lieu of this, an aggregated five by five interindustry model derived from the Alberta model will be used to illustrate the various concepts.

The aggregated model will have five endogenous sectors as follows:

1. Agriculture -- includes all agricultural grain products, livestock products and fruit and vegetable products. (Sectors 1-3 of Alberta model).

2. Minerals and Petroleum -- includes metallic and non-metallic mineral products, crude petroleum and natural gas products (Sectors 4-5 of Alberta model).

3. Food Processing -- includes all processing of primary food products. (Sectors 6-14 of Alberta model).

4. Manufacturing -- includes all manufacturing activity in Alberta (Sectors 15-29 of Alberta model).
5. Service and Unallocated -- includes utilities, transportation, communication, retail and wholesale trade, personal and business services, and unallocated products. (Sectors 30-34 of Alberta model).

The exogenous section of the model will be represented by one producing row-primary input and one purchasing column-final demand.

A slight departure will be made from the standard input-output tables discussed in Chapter IV in that two basic types of models will be used. In the preparation of Model II the standard convention of removing imports from the transactions appearing in the endogenous sector of the model has not been used. Thus the sum of the row entries for any particular sector gives the total use of that particular product, as compared to the total output value obtained from this sum in a standard model. The inverse of this model will be used to calculate the total requirements needed when given a new final demand vector. Model II has the interindustry flows shown in Table I, the direct input coefficients shown in Table II and the interdependence coefficients shown in Table III.

Model III will have the same sector aggregation as used in Model II but adopts the standard convention of entering imported inputs in a primary input row. The technical coefficients matrix and the inverse matrix of technical

TABLE I

INTERINDUSTRY FLOW OF GOODS AND SERVICES BY INDUSTRY OF ORIGIN AND DESTINATION, ALBERTA ECONOMY, 1962, MODEL II

	Thousands of dollars						
	1 Agricultural Products	2 Mineral Products	3 Agricultural Processing	4 Manufacturing	5 Services	Final Demand	Total Use
1 Agricultural Products	183,985		251,356		130	421,958	857,429
2 Mineral Products		17,343	467	111,342	14,723	530,185	674,060
3 Agricultural Processing	19,508		25,649	756	3,744	484,366	534,071
4 Manufacturing	72,101	100,608	20,921	159,673	112,550	1,218,558	1,684,445
5 Services	168,425	220,713	60,467	156,498	582,021	1,188,533	2,373,744
Primary Inputs	398,977	325,129	99,166	245,213	1,655,222	1,616,999	3,596,392
Output	842,896	658,793	457,767	673,482	2,368,390	3,596,392	8,597,392
Imports	14,533	15,267	76,305	1,010,963	5,354	-	1,122,422
TOTAL USE	857,429	674,060	534,071	1,684,445	2,373,744	3,596,392	9,720,142

TABLE II

TECHNICAL COEFFICIENTS, ALBERTA ECONOMY, 1962, MODEL II[a/]

	1 Agricultural Products	2 Mineral Products	3 Agricultural Processing	4 Manufacturing	5 Services
1 Agricultural Products	.21828		.54915		.00005
2 Mineral Products		.02632	.00102	.16533	.00622
3 Agricultural Processing	.02314		.05593	.00112	.00116
4 Manufacturing	.08554	.15272	.04571	.23705	.04752
5 Services	.19982	.33503	.13209	.23238	.24575

a) Each entry shows dollars of direct and indirect requirements for products of the Alberta sector listed at the left per dollar of final demand for products of the Alberta sector listed at the top.

TABLE III

INTERDEPENDENCE COEFFICIENTS, ALBERTA ECONOMY, 1962, MODEL IIa/

	1 Agricultural Products	2 Mineral Products	3 Agricultural Processing	4 Manufacturing	5 Services
1 Agricultural Products	1.30219	.00073	.75774	.00169	.00136
2 Mineral Products	.03344	1.07291	.03559	.23987	.02402
3 Agricultural Processing	.03265	.00099	1.07860	.00235	.00182
4 Manufacturing	.18089	.24940	.18551	1.39246	.09008
5 Services	.42129	.55379	.46260	.53641	1.36492

a/ Each entry shows the direct and indirect demand for each product in the row sector per dollar of final demand for products of the column sector. Imports are included in the total demand.

coefficients will be used in the majority of calculations made in this chapter. Tables IV, V and VI give the interindustry flows, direct input coefficients and the interdependence coefficients for Model III.

As indicated previously a single study such as this cannot assemble all possible interpretations that can be made from the input-output tables discussed in Chapter IV. Therefore, the procedure followed in the remaining sections of this study is to summarize some of the more important relationships using aggregated models for the Alberta economy as presented above.

II. ESTIMATING THE EFFECTS OF CHANGES IN FINAL DEMAND

The inverse matrix of technical coefficients set-up in tabular form can be readily used to determine the interindustry effects of changes in final demand. A brief look at the mathematical formulation of Model III can best illustrate the use of the model in estimating the effects of changes in final demand.

An input-output model may be described as in equation (1):

$$(1) \qquad X_i = \sum_{j=1}^{5} x_{ij} + Y_i$$

where X is the gross domestic output of sector i; i denotes endogenous sectors, x_{ij} is the output of the producing industry

TABLE IV

INTERINDUSTRY FLOW OF GOODS AND SERVICES BY INDUSTRY OF ORIGIN AND DESTINATION, ALBERTA ECONOMY, 1962, MODEL III

	Thousands of dollars						
	1	2	3	4	5		
	Agricultural Products	Mineral Products	Agricultural Processing	Manufacturing	Service	Final Demand	Gross Domestic Output
1 Agricultural Products	183,985		251,330		95	407,486	842,896
2 Mineral Products		16,007	467	104,131	13,723	524,465	658,793
3 Agricultural Processing	19,508		23,018	729	3,503	411,009	457,767
4 Manufacturing	47,381	46,386	11,291	81,939	78,725	407,760	673,482
5 Service	168,425	217,800	60,467	156,498	582,021	1,183,179	2,368,390
Primary Inputs	423,597	378,600	111,194	330,185	1,690,323	2,528,854	3,596,392
Gross Domestic Outlay	842,896	658,793	457,767	673,482	2,368,390	3,596,392	8,597,392

TABLE V

TECHNICAL COEFFICIENTS, ALBERTA ECONOMY, 1962, MODEL III[a/]

	1 Agricultural	2 Mineral	3 Agricultural	4 Manufacturing	5 Services
1 Agricultural Products	.21828		.54903		.00004
2 Mineral Products		.02430	.00102	.15462	.00579
3 Agricultural Processing	.02314		.05028	.00108	.00148
4 Manufacturing	.05621	.07041	.02467	.12166	.03324
5 Services	.11982	.33060	.13209	.23238	.24575

a) Each entry shows dollars of direct and indirect requirements for products of the Alberta sector listed at the left per dollar of final demand for products of the Alberta sector listed at the top.

TABLE VI

INTERDEPENDENCE COEFFICIENTS, ALBERTA ECONOMY, 1962, MODEL III[a/]

	1 Agricultural Products	2 Mineral Products	3 Agricultural Processing	4 Manufacturing	5 Services
1 Agricultural Products	1.30204	.00065	.75297	.00148	.00162
2 Mineral Products	.01826	1.04402	.01884	.18813	.01634
3 Agricultural Processing	.03245	.00089	1.07206	.00206	.00220
4 Manufacturing	.10044	.10228	.09589	1.17054	.05256
5 Services	.38957	.48945	.42503	.44383	1.34999

a) Each entry shows the direct and indirect requirements for products of the row sector per dollar of final demand for products of the column sector.

i purchased by the endogenous sector j, and Y_i is the final demand for sector i.

The assumption of constant technical coefficients which must be made in the derivation of the inverse technical coefficient matrix takes the form shown in equation (2):

$$(2) \qquad a_{ij} = \frac{x_{ij}}{X_j}$$

substituting (2) into equation (1) yields:

$$(3) \qquad X_i - \sum_{j}^{5} a_{ij} X_j = Y_i$$

This equation is representative of the distribution of output for the five endogenous sectors. The system may be written in vector form as in equation (4):

$$(4) \qquad X - AX = Y$$

in which X is a column vector of outputs (dimensions 1x5), A is the matrix of technical coefficients (dimensions 5x5), and Y is a column vector of final demands (dimensions 1x5). Solving (4) for the outputs required from each sector to deliver a specified final demand gives:

$$(5) \qquad X = (I - A)^{-1} Y$$

in which I is the identity matrix of the same dimensions as A.[14] Interpretation of this solution is as follows: Given final demands for Alberta products Y and the matrix of interdependence coefficients $(I - A)^{-1}$, specific outputs are required of each Alberta industry. Consequently, given a change in final demand for Alberta products, and the interdependence matrix, the change in output for each Alberta industry to meet the final demand may be determined. Each interdependence coefficient (A_{ij}) must, therefore, be interpreted as showing the change in output required of industry i in response to a change of one dollar in final demand for products of industry j. In this type of analysis the economy is being examined from the supply side in the sense that an attempt is made to measure the total supply of domestic production required to meet a given final demand.

The assumption is also made that the proportion of imported inputs for each industry i remains fixed. If new sources of supply were made available from within the Province for inputs which were formerly imported, the proportion of imported inputs would thus change. As a result of this change, output projections made with the inverse matrix would be

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[14] This is identical to the solution shown in equation 19 in Appendix A in the discussion of the basic theoretical model.

inaccurate. Changes in the types of products produced domestically are very possible when a regional economy such as a province is studied. The production mix of a regional economy is not as stable as that of a larger economy such as the Dominion of Canada.

To overcome this problem in the study of the economy of Alberta, the preparation of Model II was deemed necessary. Model II, as described earlier, has not had the imported inputs segregated from the other inputs. Thus, in the interpretation of the solution of equation (5) for Model II, reference is made to the change in demand for each product type produced by industry j. In this analysis the demand side of the economy is being examined.

Projecting a new final demand vector with increases of 10 percent for all sectors, a study may be made of the total domestic supply requirements and the total demand requirements. The total output requirement as calculated from the inverse matrix of Model III are shown in Table VII. Table VIII illustrates the total demand for goods and services required to meet the new final demand vector, as calculated from the inverse matrix of Model II. From these tables it can be clearly indicated which sectors are most dependent on imported inputs.

TABLE VII

IMPACT ON REGIONAL OUTPUT INDUCED BY CHANGES IN FINAL DEMAND, ALBERTA, 1962, MODEL III

	10 per cent change in final demand	change in Regional Output	Ratio of output change to final demand change
	Thousands of dollars		
1 Agricultural Products	40,749	84,283	2.068
2 Mineral Products	52,447	65,879	1.256
3 Agricultural processing	41,101	45,776	1.114
4 Manufacturing	40,776	67,347	1.652
5 Service	118,318	236,838	2.002

TABLE VIII

IMPACT ON REGIONAL DEMAND INDUCED BY CHANGES IN FINAL DEMAND, ALBERTA, 1962, MODEL II

	10 per cent change in final demand	Change in demand	Ratio of output change to final demand change
	Thousands of dollars		
1 Agricultural Products	42,196	85,741	2.032
2 Mineral Products	53,019	67,466	1.271
3 Agricultural processing	48,437	53,407	1.103
4 Manufacturing	121,856	168,444	1.382
5 Service	118,853	237,373	1.997

The ratio of output change to final demand change indicates analytically what portion of the total output is used by the domestic processing sectors of the economy. A high value indicates a large amount of intermediate use for the particular product.

Direct comparisons of Table VII and Table VIII clearly indicate originating sectors of large values for imported goods and services. (Change in demand less change in domestic output equals net imports)

The tables become most useful when different changes in final demand for each producing sector of the economy are projected. When this is done, output does not change by exactly the same percentage as final demand, since indirect effects will be different for each sector. In the simplified calculations made in the accompanying tables the indirect effects are the same throughout, since final demand (and output) changed by 10 percent for all sectors. It would have been different had final demand risen by, say 25 percent, for some sectors, while remaining fixed for others.

III. OUTPUT MULTIPLIERS

In the following analysis of output multipliers and the other measure of growth studied in the final sections of the chapter, Model III will be used exclusively since Model II

does not give complete and descriptive pictures of transactions taking place within the economy.

Equation (6) shows the matrix of interdependence coefficients $(I - A)^{-1}$ written in expanded form.

$$\begin{array}{llll} A_{1.1} & A_{1.2} & \cdots\cdots & A_{1.5} \\ A_{2.1} & \cdots\cdots & \cdots\cdots & A_{2.5} \\ \vdots & & & \vdots \\ A_{5.1} & A_{5.2} & \cdots\cdots & A_{5.5} \end{array} \tag{6}$$

If $A_{1.1}$ shows the output of industry 1 to deliver one dollar's worth of products of industry 1 to final demand, then $A_{i.1}$ shows the output required of industry i to deliver one dollar's worth of product of industry 1 to final demand. The sum $A_{1.1} + A_{2.1} + A_{3.1} + A_{4.1} + A_{5.1}$ shows the total output required of all endogenous sectors to deliver one dollar's worth of products of industry 1 to final demand. Equivalent interpretations may be made for each column of the interdependence matrix $(I - A)^{-1}$.

These column totals are termed output multipliers. Each multiplier expresses the total change in the value of Alberta's gross domestic output induced by a one dollar change in final demand for the products of a particular sector.[15](see following page for footnote) Each Alberta sector may, therefore, be ranked in order of its relative output-inducing capability per

dollar of final demand. The ranking of these measures computed for Model III are shown in Table IX.

Clearly agricultural processing has the largest output inducing capability for the Alberta economy. The large output multipliers indicate that a sector is very dependent on domestic output for its inputs. Thus any increase in output of these sectors causes larger increases in other sectors through its demand for their output. A sector with extremely large amounts of imported inputs, i.e. service sector, has a low output multiplier.

IV. WEIGHTED OUTPUT MULTIPLIERS

Another useful comparison between sectors of the Alberta economy is the weighted output multiplier. The weighted

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[15] It is interesting to compare this multiplier with the "investment multiplier" of Keynesian theory. Although both multipliers reflect changes in national (or provincial) product resulting from changes in consumption or investment, the Keynesian multiplier implies the adjustment of the economy to a general equilibrium solution of savings, consumption and investment. Input-output analysis as represented here more closely resembles a technical production analysis showing interdependence between sectors of an economy.

There is an input-output multiplier for each sector of the economy and each multiplier expresses the aggregate effect on domestic production caused by a given change in final demand. Since the model under consideration is "open" and not "closed" in the Keynesian sense, solutions for output multipliers are "partial" since exogenous sectors are not considered. Further consumption by any exogenous sector will also have a multiplicative effect on output. The exogenous multiplicative effects are critical in Keynesian theory on multipliers and herein lies the difference between the two measures. Keynesian multipliers, however, do not specify particular interrelationships between sectors as may be done with output multipliers in input-output analysis.

TABLE IX

OUTPUT MULTIPLIER EFFECTS OF A ONE DOLLAR CHANGE IN FINAL DEMAND FOR PRODUCTS OF ALBERTA INDUSTRIES, 1962, MODEL III

Sector number	Sector	Output multiplier[a]	Rank[b]
1	Agricultural Products	1.84278	2
2	Mineral Products	1.63728	4
3	Agricultural Processing	2.34679	1
4	Manufacturing	1.80603	3
5	Service	1.42271	5

a) Total change in gross output within the Alberta economy induced by a change in delivery of one dollar to final demand by the sector listed.

b) Multipliers are ranked in order from highest to lowest.

multipliers are derived by weighting the output multipliers discussed in Section III by a specific percent of final demand expressed in dollar values. This measure presents a more realistic comparison between sectors since some consideration is made of the contribution to final demand. Indirectly, the absolute size of the output of each sector is considered in the multiplier. Since the weighted multiplier does consider size of final demand and output, as well as the output inducing capability of each sector, it is perhaps the best overall measure of the importance of a particular sector to the entire economy.

The weighted output multiplier is shown in equation (7),

$$\sum_{i=1}^{5} X_i = \sum_{i=1}^{5} A_{ij} \quad Y_j \tag{7}$$

where $\sum_{i}^{5} X_i$ expresses the total output change (weighted output multiplier) associated with a specific final demand change (Y_j) for sector j and $\sum_{i}^{5} A_{ij}$ is the output multiplier for sector j.

Output multipliers for each sector listed in Model III have been weighted with 10 percent of their respective final demands as shown in Table X.[16]

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[16] The change of ten percent in final demand was selected arbitrarily but appears to be within the realm of possible short-run changes.

TABLE X

WEIGHTED OUTPUT MULTIPLIERS FOR ALBERTA INDUSTRIES, 1962, MODEL III

	1962 final demand level	Weighted output multipliers[a]	Rank of weighted output multiplier	Rank of unweighted multiplier[b]
	Thousands of dollars			
1 Agricultural products	407,486	75,091	4	2
2 Mineral Products	524,465	85,870	3	4
3 Agricultural processing	411,009	96,455	2	1
4 Manufacturing	407,760	73,643	5	5
5 Services	1,183,179	168,332	1	3

a) Output multipliers (Table IX) for each sector are multiplied by an amount equal to 10 per cent of the 1962 final demand shown in column 1.

b) See Table IX for output multipliers.

The weighted output multipliers tend to average the unweighted output effects and the final demand impact of each sector since output value to final demand and interindustry effect are used in calculating the weighted multipliers. The large deliveries to final demand by the service sector tend to overcompensate for the lower interindustry effects of the sector and thus a large weighted multiplier is evident. The agricultural processing sector remains highly important to the economy, because of its output inducing capability and its deliveries to final demand.

V. INDIRECT INTERDEPENDENCE BETWEEN SECTORS

Each interdependence coefficient given in the inverse matrix $(I - A)^{-1}$ relates required direct and indirect inputs to final demand levels. The coefficients in the technical coefficient matrix (Table V) relate direct input to levels of output. The two matrices may not be directly compared since interdependence coefficients refer to final demand effects and technical coefficients refer to output effects.

However, interdependence coefficients may be reduced in value to reflect only direct and indirect effects of output changes by dividing each column entry by the main

diagonal column entry.[17] The result is to net out internal flows within sectors j generated by final demand for industry j, as well as further flows from other sectors induced by these internal flows within the sector. Output requirements from industry j per dollar of final demand for products of industry j are now one dollar and as a result output requirements per dollar of final demand of industry j for other sectors is now per dollar of output of sector j. In this way each column of the interdependence matrix may be changed to read direct and indirect requirements per dollar of output of each purchasing industry j.

The matrix of interdependence coefficients representing direct and indirect purchases per dollar of output for Model III is shown in Table XI. It is possible now to compare the direct requirements per dollar of output shown in Table V with the direct and indirect requirements shown in Table XI.

By subtracting each direct coefficient in Table V from its corresponding direct plus indirect coefficient in Table II (excluding those in the diagonal) the matrix of indirect requirements per dollar of output given in Table XII is

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[17] The main diagonal is the diagonal formed by proceeding from the upper left hand corner to the lower right hand corner of the inverse matrix.

TABLE XI

ADJUSTED INTERDEPENDENCE COEFFICIENTS, ALBERTA ECONOMY, 1962, MODEL III[a/]

	1 Agricultural Products	2 Mineral Products	3 Agricultural Processing	4 Manufacturing	5 Services
1 Agricultural Products	1.00000	.00062	.70236	.00126	.00120
2 Mineral Products	.01402	1.00000	.01757	.16072	.01210
3 Agricultural Processing	.02492	.00089	1.00000	.00176	.00163
4 Manufacturing	.07714	.09797	.08944	1.00000	.03893
5 Services	.29920	.46881	.39646	.37917	1.00000

a) Each entry shows the direct and indirect requirements for products of the row sector per dollar of output of the products of the column sector.

TABLE XII

INDIRECT REQUIREMENTS PER DOLLAR OF OUTPUT, ALBERTA, 1962, MODEL III[a/]

	1 Agricultural Products	2 Mineral Products	3 Agricultural Processing	4 Manufacturing	5 Services
1 Agricultural Products	[b/]	.00062	.15333	.00126	.00116
2 Mineral Products	.01402	-	.01655	.00610	.00631
3 Agricultural Processing	.00178	.00089	-	.00068	.00015
4 Manufacturing	.02093	.02756	.06477	-	.00569
5 Services	.17938	.13821	.26437	.24708	-

a) Each entry shows the indirect requirements for products of the row sector per dollar of output of products of the column sector.

b) The entries in the main diagonal are meaningless and thus excluded.

constructed. This table makes it possible to compare the indirect requirements to the direct requirements and thus analyze the importance of the indirect requirements to each sector of the economy. For this purpose a table of ratios of indirect to direct requirements as generated by changes in output may be computed. A list of these ratios can be found in Table XIII. Each entry is the proportion that indirect requirements of the row sector i are of the corresponding direct requirements. For example, a change in output of one dollar for the agricultural sector would generate 37.2 percent as much indirect requirements from the manufacturing sector as it would direct requirements. Each entry in Table XIII may be evaluated in a similar manner. These ratios may illustrate areas where the direct dependence between sectors grossly understates their total dependence.[18]

As an example it is possible to evaluate the importance of water when it is entered as row and column vectors in the interindustry model. Sectors that may not initially prove to be dependent on water inputs may be found to be very dependent indirectly on water inputs to other sectors. Thus it may be possible to analyze the indirect benefits attributable to water inputs.

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[18] It must be noted that the indirect requirements include only first order approximations as take place in an iterative process. It is also true that the first order effects are by far the largest.

TABLE XIII

RATIOS OF INDIRECT TO DIRECT REQUIREMENTS, ALBERTA ECONOMY, 1962, MODEL III[a/]

	1 Agricultural Products	2 Mineral Products	3 Agricultural Processing	4 Manufacturing	5 Services
1 Agricultural Products	b/	c/	.279	c/	29.000
2 Mineral Products	c/	-	16.225	.039	1.090
3 Agricultural Processing	.077	c/	-	.630	.101
4 Manufacturing	.372	.391	2.625	-	.171
5 Services	1.497	.418	2.001	1.063	-

a) Each entry shows the proportion that indirect requirements of the column sector for products of the row sector are of the corresponding direct requirements.

b) Ratios are not applicable for the diagonal elements.

c) No direct requirements exist for these cells.

VI. REQUIREMENTS OF PRIMARY RESOURCES

The available supply of primary resources inputs such as land, water, labor and capital is not considered a function of the "open" input-output system as are the inputs of most domestically produced products. They are in effect considered as exogenous or autonomous factors and as such are treated as given. On the output side, however, inputs of these resources are a function of output and final demand levels.

The inverse matrix of interdependence coefficients for the Alberta economy provides the basis for predicting each sector's output for a given level of final demand.[19] If the functional relationship between primary resource requirements and output is known, total resource requirements, (direct plus indirect) for a given final demand, may be computed.

That is, where w_j is the amount of primary resource w required by sector j and X_j is the output of sector j then;

$$(8) \qquad W_j = f\ (x_i)$$

---

[19] Reference to Section II of this Chapter provides illustration of this concept.

For empirical purposes the assumption is made that the form of the functional relationship is given by equation (9).

(9) $$w_j = b_j X_j + C_j \quad \text{where} \quad C_j = 0$$

Technical coefficients b_j of resource use are thus derived from a single observation of resource input for a given output level as shown in (10).

(10) $$b_j = w_j \,/\, X_j$$

Further, it is possible to define the total requirements for primary resource w as W and thus in algebraic terms:

(11) $$W = \sum_{j=1}^{n} W_j = \sum_{j=1}^{n} b_j X_j$$

or in matrix notation.

(12) $$W = bX$$

where b is the w^{th} row of a resource matrix B and X is a vector of outputs.

Substituting X from equation (5) into equation (12) equation (13) is obtained.

(13) $$W = b(I - A)^{-1}\, Y$$

If a vector of resource inputs b is entered as the diagonal of an $n \times n$ matrix, a matrix of coefficients $[b(I-A)^{-1}]$ expressing resource inputs w_{ij} per dollar of delivery to final demand is created by multiplying the matrix of resource coefficients b by the matrix of interdependence coefficients $(I - A)^{-1}$. This matrix shows the resource interaction per unit change in final demand.

The matrix is used to calculate resource use multipliers which are useful to identify sectors that are indirectly dependent on inputs of primary resources. The methodology used to calculate the multipliers is similar to that used in Section III of this chapter to calculate output multipliers. The multipliers are derived by dividing the values in each row by the diagonal element of that row and summing the results for the row. A resource use multiplier may be calculated for each producing row in this way. The direct and indirect requirement of the primary resource are reduced from requirements per dollar of final demand delivered by the producing sector to requirements per unit of primary resource used directly by the producing sector. Thus the indirect and direct requirement of each primary resource may be compared. For example, if the resource use multipliers equal 2.20 and if the direct use of the primary resource is 1.00 units, it is clear that for each 1 unit of resource used directly the sector requires that 1.20 additional units of the resource be produced or made available indirectly.

This type of analysis lends itself to the evaluation of the measurement of water resource requirement of the Province. Using the inverse matrix of Model III and estimates of direct water requirements per dollar of output for the five endogenous sectors in Model III, it is possible to indicate the total dependence of the economy on water. Sectors which are highly dependent on water in an indirect manner may be identified by the resource use multipliers and the importance of water better analyzed.

The direct water use requirements per dollar of output for the five sectors of Model III are given in the Table XIV. The water interactions found by multiplying the matrix of water use coefficients w by the inverse matrix $(I-A)^{-1}$ for Model III are given in Table XV.[20] The matrix of direct and indirect requirements per unit of water used directly by each sector as derived using the theory described earlier is found in Table XVI. The water use multipliers derived from the interaction coefficients are shown in Table XVII.

Thus although the water use requirements listed in Table XIV for the service sector are small, the entries in Table XVII indicate that the sector is indirectly highly

---

[20] The matrix algebra used to arrive at these various concepts is found in Appendix A.

TABLE XIV

WATER REQUIREMENTS FOR SECTORS OF THE ALBERTA ECONOMY, 1962a/

	Water Coefficients b/ (acre feet)
1 Agricultural products	1525.0
2 Minerals products	380.0
3 Agricultural processing	25.5
4 Manufacturing	65.0
5 Service	19.7

a/ Each water coefficient represents total water use per one million dollars of output for the sectors of the Alberta economy in 1962.

b/ The water coefficients were derived from a study of water requirements for the State of California by E. M. Lofting and P. H. McGauhey. For details see: Lofting, E. M., and P. H. McGauhey. Economic Evaluation of Water, Part III An Interindustry Analysis of the California Water Economy. U. C. Water Resources Center Contribution No. 67, Berkeley. Sanitary Engineering Research Lab., University of California, 1963.

TABLE XV

TOTAL WATER USE INTERACTIONS, ALBERTA, 1962, MODEL III[a/]

	1 Agricultural Products	2 Mineral Products	3 Agricultural Processing	4 Manufacturing	5 Services
1 Agricultural Products	1985.6	.2	19.2	.1	0
2 Mineral Products	27.8	396.7	.5	12.2	.3
3 Agricultural Processing	49.5	.3	27.3	.1	0
4 Manufacturing	153.2	38.9	2.4	76.1	1.0
5 Services	594.1	186.0	10.8	28.8	26.6

a) Each entry gives the direct and indirect requirements in Acre feet per one million dollar change in final demand.

TABLE XVI

DIRECT AND INDIRECT WATER REQUIREMENTS PER UNIT OF WATER USED DIRECTLY BY EACH PRODUCING SECTOR OF THE ALBERTA ECONOMY, 1962, MODEL III[a]

	1 Agricultural Products	2 Mineral Products	3 Agricultural Processing	4 Manufacturing	5 Services
1 Agricultural Products	1.00	[b]	.01	-	-
2 Mineral Products	.07	1.00	-	.03	-
3 Agricultural Processing	1.81	.01	1.00	-	-
4 Manufacturing	2.01	.51	.03	1.00	.01
5 Services	22.33	6.99	.41	1.08	1.00

a) Each entry gives the total direct and indirect water requirements for the producing sectors in acre feet per unit of water used directly to produce their output.

b) Less than 0.01

TABLE XVII

WATER USE MULTIPLIERS FOR SECTORS OF THE ALBERTA ECONOMY, 1962, MODEL III

	Water use multipliers[a]	Ranks[b]
1. Agricultural products	1.01	5
2. Mineral products	1.10	4
3. Agricultural processing	2.82	2
4. Manufacturing	2.56	3
5. Services	32.81	1

a) Values indicate total direct plus indirect dependence on inputs of water per unit of water used directly to produce the products of each sector listed at the left.

b) Rankings are arranged in order from highest to lowest.

dependent on water inputs. This is indicated by the large value found in the service row of Table XVII. Clearly the agricultural products sector is very directly dependent on water inputs, but, since the sector does not make large inter-industry purchases, the indirect requirements are nil. However, it is possible to reach the conclusion that inputs of water to the agricultural products sector have a large effect on the economy as a whole. (Reading column 1, Table XV). The conclusions arrived at from Tables XVI and XVII are but examples of the many interpretations that are possible concerning Alberta water economy. The obvious generalizations made by the aggregated model are not of great use for the allocation of water resources. A detailed study using the complete 34 by 34 sector model should prove invaluable in the analysis of water and other primary resources.

VII. IMPORT MATRIX

The final application of the Alberta input-output models was the preparation of an aggregated import matrix. Since regional economies are extremely dependent on imported inputs, any changes in the structure of import flows are very important to economic planners. An import matrix showing the imports (purchased by each Alberta sector,) categorized by product type in an input-output framework would provide an insight into the pattern of import flows.

By pulling the imports out of each cell of an interindustry transactions matrix (as shown in Table 1, Model II) it is possible to derive a square matrix giving the imports of each "industry type" used by each sector of the economy. Equation 14 presents a typical import matrix written in expanded form:

$$
(14) \qquad \begin{array}{cccc}
M_{11} & M_{12} & \cdots\cdots & M_{15} \\
M_{21} & M_{22} & \cdots\cdots & M_{25} \\
\vdots & & & \vdots \\
M_{51} & M_{52} & \cdots\cdots & M_{55}
\end{array}
$$

where: M_{11} = the imports of type produced by industry 1 used by sector 1.

M_{i1} = total imports purchased by sector 1.

M_{1j} = total imports of the type produced by sector 1, purchased by all sectors of the economy.

The detailed matrix may be developed by disaggregating the economy into 150-200 sectors and tracing the purchases and sales of imports throughout the economy. This model may then be aggregated into a smaller number of sectors to provide ease of handling and simplify the calculations when the model is applied analytically.

Specific uses of the import matrix are numerous since it allows for the tracing of all types of imports used in the economy. It should prove to be an excellent descriptive tool

when used to analyze possible areas for new industrial development in the province. Since the users of specific types of imports are indicated, a ready-made market analysis is available to new industries.

Although the descriptive uses of the model are the most obvious at the present time, it may also be possible to use it for analytical purposes. When used together with an interdependence matrix it would be helpful in specifying certain levels of imports needed to meet a new final demand schedule.[21] This could be done by either of the following two methods:

1. From the import flow matrix one could calculate an import input coefficient matrix by normalizing the column entries using total output of the purchasing sector as a base. The import input coefficient matrix could then be used to find new levels of imports by multiplying each column vector by the output level derived from the interdependence matrix given the new final demand schedule. Thus one would have a matrix of import requirements for the economy.
2. Using an inverse import matrix derived from the import input coefficient matrix it would be possible to calculate total import requirements of each producing type. The

---

[21] The necessary assumption of constant import coefficients may limit the usefulness of the model in the case. Since the import structure of a regional economy changes rapidly it is doubtful if the coefficients would remain constant for even a short period of time.

multiplication of an import output matrix (normalized using total imports of each product type) by the import levels would provide a required level of imported inputs for each sector for the new final demand schedule.

Theoretically these methods should arrive at the same level of imported inputs for each sector. The time element in this study makes it impossible to prove, or as the case may be, disprove this theory.

To cite a simplified example; it is possible to develop a table of aggregated import flows as shown in Table XVIII by comparing the respective entries in each cell of Tables I and IV. (One need merely subtract the cell entry in Table IV from that in Table I to arrive at import flows). Using the new output levels for the 10 percent change in final demand calculated in Section II of this chapter, one may derive the new import requirements reported in Table XIX by method 1 developed previously.

Although this is a greatly simplified example of the use of the import matrix it does give a general picture of the import flows for Alberta.

The import flows needed to supply final demand with one dollar of output from each sector of the Alberta economy are shown in Table XIX. If one were to assume constant import input coefficients the flows would show the imports necessary

TABLE XVIII

MATRIX OF IMPORT COEFFICIENTS, ALBERTA, 1962, MODEL III[a]

	1	2	3	4	5
	Agricultural Products	Mineral Products	Agricultural Processing	Manufacturing	Services
			(Thousands of Dollars)		
1 Agricultural Products			26		35
2 Mineral Products		1,336		7,211	1,000
3 Agricultural Processing			2,631	27	241
4 Manufacturing	24,720	54,222	9,630	77,734	33,825
5 Services		2,913			

a) Each entry indicates the imports of goods (catagorized by the processing sectors at left) purchased by the sectors at the top for production of their output.

TABLE XIX

IMPORT REQUIREMENTS FOR EACH ALBERTA SECTOR TO MEET A 10 PER CENT CHANGE IN FINAL DEMAND OF GOODS AND SERVICES FOR ALL SECTORS, 1962, MODEL IIIa/

	Thousands of dollars					
	1 Agricultural Products	2 Mineral Products	3 Agricultural Processing	4 Manufacturing	5 Services	Total Imports c/
1 Agricultural Products			3		4	7
2 Mineral Products		134		721	100	955
3 Agricultural Processing			263	3	24	290
4 Manufacturing	2472	5422	963	7773	3383	20,013
5 Services		291				291
Total imported Inputs b/	2472	5847	1229	8497	3511	21,556

a) The new output levels are given in Table VII.

b) Total imported inputs used by each column sector.

c) Total imports catagorized by the sector of origin.

for each sector to produce their output. The tracing of the flows may reveal markets for new products which may be produced in the province. For example, the large value of imported inputs purchased from the manufacturing sector by the mineral products sector could open up new areas of domestic production. These, of course, would need to be evaluated in terms of alternative costs and welfare maximization objectives. The alternative costs could conceivably be incorporated into an objective function which is a mathematical expression of welfare. Given such an objective function, one could derive some welfare maximizing solutions by use of linear programming methods.

VIII. SUMMARY

The simplified calculations discussed in this chapter have been devised to provide a general picture of the Alberta economy. This is in no way intended to be a complete or detailed study of the Alberta economy using the input-output tables. They do, however, provide methodological schema by which both the private and public sectors can evaluate resource allocation and markets, given growth targets or projections.

CHAPTER VI

SUMMARY AND CONCLUSIONS

This study has summarized the emperical results and illustrated the underlying theoretical models of interindustry analysis for the Alberta Economy in 1962. A structural model of interdependence was constructed using the input-output technique of analysis. The input-output model was then utilized to quantify and analyze the interaction of economic sectors within the province. Water inputs were used as one of a number of criteria to aggregate the vast number of firms in the economy into a workable number of sectors. Three agricultural, two mineral product, nine agricultural processing, fifteen manufacturing and five service sectors were included in the endogenous section of the model. The exogenous section was composed of six rows of primary inputs and five columns of final demand.

Dollar transactions between producing and purchasing sectors of the economy were estimated; first by the use of a sample survey and second by supplementary data from various publications. The interindustry flows presented in Table XXX, Appendix C, summarizes the dollar transactions.

Technical coefficients showing the value of direct inputs from each sector and the value of direct output for each sector per dollar of output were computed from the transactions flow table and are presented in Tables XXXI and XXXII (Appendix C). The interdependence coefficients as derived from the technical input coefficients are presented in Tables XXXII (Appendix C).

The apparent interaction between sectors in the Alberta economy was examined by the use of aggregated input-output tables derived from the Alberta tables. The aggregated tables were composed of the following five sectors:

1. Agricultural products.
2. Mineral products.
3. Agricultural Processing industries.
4. Manufacturing industries.
5. Service industries.

The analysis conducted with these models indicates the importance of agricultural products to the Alberta economy. Although agricultural processing appears to induce the largest output per dollar delivered to final demand it must be noted that the agricultural products sectors supplies the majority of inputs to this sector.

The manufacturing sector appears to have the smallest impact on the Alberta economy, basically because; (1) a large

portion of goods produced are used domestically, and (2) a large percentage of the manufactured goods used are imported. Contrary to common belief, the petroleum industry does not have a large impact on the interindustry flows for Alberta. This is mainly because a large percentage of the petroleum products are exported. Again, much of the inputs required by the industry are imported.

The basic assumptions of the input-output models developed are; (1) each technical input coefficient is assumed to be fixed (2) aggregation errors are absent in combining industries and products into sectors. These assumptions may limit the usefulness of the conclusions reached in the foregoing analysis. Although tests of the validity of the assumptions have been made by researchers these tests do not hold when a regional economy is under analysis. The smaller the region under consideration, the greater the relative importance of imports and thus greater potential exists for the technical input coefficients to change with the passage of time. Thus, the margin of error in predictive results is greater in the Alberta model than in national models previously formulated.

Although limitations exist, when the results presented herein are interpreted with caution they can provide much needed additional quantitative information on the structural interdependence of the Alberta economy.

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APPENDIX A

MATHEMATICAL FRAMEWORK AND MATRIX ALEBRA OF INPUT-OUTPUT ANALYSIS

I. MATHEMATICAL FRAMEWORK

An input-output model is a set of linear equations describing the intersectoral flows of goods and services. The various stages of construction of the model may best be described using a theoretical three by three input-output model. An open system of intersectoral flows may be described mathematically as in (15) below.

$$
\begin{aligned}
X_1 &= X_{11} + X_{12} + X_{13} + Y_1 \\
X_2 &+ X_{21} + X_{22} + X_{23} + Y_2 \qquad (15) \\
X_3 &= X_{31} + X_{32} + X_{33} + Y_3
\end{aligned}
$$

in which X_1 is the output of sector 1, X_{12} is the amount of output of sector 1 purchased by sector 2, and Y_1 is the final demand for the products of sector 1.

Secondly, the assumption of constancy of technical input coefficients is made as shown in (16).

$$
(16) \qquad aij = \frac{X_{ij}}{X_j}
$$

Arranging the technical coefficients in matrix form the matrix of technical coefficient can be written as follows:

$$(17) \qquad A = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$$

The technical coefficients serve to explain the direct requirements per dollar of output for each industry.

Substituting (16) in the form $X_{ij} = {}_{aij}X$; into (15) the flow equation (after simple transposition of the terms) becomes:

$$(18) \qquad \begin{aligned} X_1 - a_{11}X_1 - a_{12}X_2 - a_{13}X_3 &= Y_1 \\ X_2 - a_{21}X_1 - a_{22}X_2 - a_{23}X_3 &= Y_2 \\ X_3 - A_{31}X_1 - a_{32}X_2 - a_{33}X_3 &= Y_2 \end{aligned}$$

In matrix notation:

$$(19) \qquad \begin{bmatrix} (1 - a_{11}) & - a_{12} & - a_{13} \\ - a_{21} & (1-a_{22}) & - a_{23} \\ - a_{31} & - a_{32} & (1-a_{33}) \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix}$$

or

$$(20) \qquad (I - A)X = Y$$

where I is the identity matrix

$$(21) \qquad I = \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix}$$

The left hand member of equation (19) and (I-A) in equation (20) is the Leontief matrix described in Chapter II. The inverse of a matrix is defined as that matrix which when multiplied by the original matrix A gives the identity matrix I. Thus

$$(22) \qquad A\,A^{-1} = I$$

By obtaining the inverse of the matrix (1-A) and solving for X the general solution of the system can be given as:

$$(23) \qquad X - (I-A)^{-1}Y = BY$$

or

$$(24) \qquad \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix}$$

Where the b_{ij}'s are the coefficients of the inverse of the technological matrix. By choosing levels of Y; the corresponding levels of output X can be obtained by performing the indicated matrix multiplication. Examples of this procedure are shown in Chapter V.

where [illegible] matrix.

[illegible]

[illegible]

[illegible]

[illegible] is given as

[illegible]

where

[illegible]

where [illegible]

II. MATRIX ALGEBRA[22]

A matrix is defined as a rectangular array of elements arranged in rows or columns as in:

$$(25) \qquad A = \begin{bmatrix} a_{11} & a_{12} & \text{------} & a_{1n} \\ a_{21} & a_{23} & \text{------} & a_{2n} \\ a_{m1} & a_{m2} & \text{------} & a_{mn} \end{bmatrix}$$

If it has mn elements arranged in m rows and columns, it is said to be of order m × n. A matrix of order 1 × n contains only a single row of elements and is referred to as a row vector, for example:

$$(26) \qquad b = \begin{bmatrix} b_1 & b_2 & \text{------} & b_n \end{bmatrix}$$

while a matrix of order m × 1 is a column vector,

$$(27) \qquad C = \begin{bmatrix} C_1 \\ C_2 \\ C_m \end{bmatrix}$$

---

[22] See Johnston J. Econometric Methods, New York, McGraw-Hill, 1960. Chapter III.

Matrix Multiplication:

Scalar Multiplication

If K is a scalar, then we define scalar multiplication such that $KA = \left[K a_{ij} \right]$ that is, each element of A is multiplied by K. For example, if

$$A = \begin{bmatrix} 2 & 0 \\ -5 & 6 \end{bmatrix} \qquad \text{and} \qquad K = -5$$

then

$$KA = \begin{bmatrix} -10 & 0 \\ +25 & -30 \end{bmatrix}$$

Matrix Multiplication

If A is of order $m \times n$ and B is of order $n \times p$ then the product AB is defined to be a matrix of order $m \times p$ whose ij^{th} element is $C_{ij} = \sum_{k=1}^{n} a_{ik} b_{kj}$ that is, the ij^{th} element in the product matrix is found by multiplying the elements of the i^{th} row of the first matrix by the corresponding elements of the j^{th} column of the second matrix and summing over all terms. Thus it is clear that the number of elements in a row of the first matrix has to be equal to the number of elements in a column of the second matrix. It is also important to note the order of the matrices in multiplication.

In AB one refers to A being postmultiplied by B, or to A premultiplying B.

For example:

$$A = \begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$$

$$B = \begin{bmatrix} 3 & 0 \\ 1 & 2 \end{bmatrix}$$

$$AB = \begin{bmatrix} 7 & 2 \\ 4 & 2 \end{bmatrix} \qquad BA = \begin{bmatrix} 6 & 3 \\ 4 & 3 \end{bmatrix}$$

Diagonal Matrix:

A diagonal matrix has scalar elements, not necessarily equal, in the principal diagonal and zeros in the off-diagonal elemental positions, i.e.

$$(28) \qquad A = \begin{bmatrix} a_{ij} \end{bmatrix} \quad \begin{matrix} i_{1j} = 1_1 2_1 - - - - n \\ aij = 0_1 \quad i \neq j \end{matrix}$$

or

$$(29) \qquad A \quad \begin{bmatrix} a_{11} & 0 & 0 \\ 0 & a_{22} & 0 \\ 0 & 0 & a_{33} \end{bmatrix}$$

The identity matrix is thus a special form of a diagonal matrix.

The Inverse Matrix:

In scalar algebra we have

$$(30) \qquad XX^{-1} = X^{-1}X = 1$$

This suggests that in matrix algebra we ask whether a matrix A^{-1} exists such that:

$$(31) \qquad AA^{-1} = A^{-1}A = 1$$

A^{-1} is defined as the inverse of A.

The calculation of an inverse matrix may be described as follows:

$$\text{Let} \quad A = \begin{vmatrix} 2 & 3 \\ 4 & 1 \end{vmatrix}$$

and

$$A^{-1} = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}$$

and

$$I = \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix}$$

Thus $AA^{-1} = I$

therefore:

$$\begin{vmatrix} 2 & 3 \\ 4 & 1 \end{vmatrix} \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix}$$

and

$$a_{11}(2) + a_{21}(3) = 1$$

$$a_{12}(2) + a_{22}(3) = 0$$

$$a_{11}(4) + a_{21}(1) = 0$$

$$a_{12}(4) + a_{22}(1) = 1$$

Solving for a_{11}, a_{12}, a_{21} and a_{22} one may obtain the inverse matrix:

$$A^{-1} = \begin{bmatrix} -\frac{1}{10} & \frac{3}{10} \\ \frac{2}{5} & -\frac{1}{5} \end{bmatrix}$$

This is but one of many methods of calculating the inverse matrix. In any matrix larger than order 3 by 3 a digital computer should be used to calculate the inverse.

APPENDIX B

CONSTRUCTION OF THE INPUT-OUTPUT FLOW TABLES-DATA SOURCES AND ADJUSTMENTS

I. INTRODUCTION

This statistical appendix provides an account of the definitions, assumptions, data sources and estimating techniques used in deriving the individual output and input estimates for construction of the Alberta interindustry flow table. The purpose of this appendix is to: (1) provide the reader with a better basis for judging the reliability of the data presented in the flow tables, and (2) present additional details on individual sectors so that other researchers may have a basis for re-aggregating the model to meet their own needs.

Sources quoted and procedures outlined relate specifically to the completed flow table. Frequently other procedures were attempted and discarded as impractical, but only the final estimating techniques used are discussed.

II. CONCEPTS AND CONVENTIONS

Valuation of Transactions

The dollar values of transactions in the flow table are shown in purchasers' prices. In purchasers' prices the consuming industry pays the total cost of an input, including

distribution charges, directly to the producing industry. The producing industry pays the trade and other margins associated with the distribution of its output.

Trade

The input-output flow tables do not trace the actual flows of goods and services to and from the trade industry. If the retail and wholesale trade industries were shown as buying and reselling goods the detailed connections would be between the trade and producing industries while the consuming industries would buy all inputs from a single source - the trade industry. Thus the actual flow of goods is traced between the producing and final consuming industries and the output of the trade sector is measured in terms of total margins - operating expense plus profit.

Secondary Products

Once individual establishments are classified into industries their entire output, subsidiary as well as principal, is counted as part of the output of the industry. Its principal output, (that what determines the classification of the industry), is called primary output, the subsidiary output is called secondary. Since the classification of the firms into industries assumes homogeniety in products, the secondary products present a special problem in that an element of heterogeniety is introduced.

A further problem is created since the secondary product of one industry is likely the primary product of another industry, thus two sources of supply are available for the same product.

The most straightforward solution to this problem is the removal of the output of secondary products to the industry in which it is a primary product. The value of output of the secondary product would be subtracted from the industries output total and added to the output total of the industry which produces it as a primary product. Similarily the various goods ,services and primary inputs used to produce the secondary product must be removed and transfered to the industry to which the product is primary.

In practice difficulties arise in the identification of the inputs used to produce the secondary product.

In the Alberta model this method of reallocation of secondary products was used where possible. Fortunately many firms producing large quantities of more than one product filed spearate statements with the Provincial Bureau of Statistics and as a result the secondary products were easily placed. As well, the use of a relatively small number of sectors in the Alberta model helped to reduce the occurrence of important secondary products in that the sectors covered broad industry classifications.

Imports

It was assumed that all imports were of a non-competitive nature in that they were not directly substitutable for domestically produced goods and services. In taking this stand on imports one must look at the imports in a detailed classification and not in the same classification used for the Alberta model. Thus, the imports were identified by individual products and allocated to the purchasing industry.

An import study made by the Alberta Bureau of Statistics for the years 1949, 1954 and 1957 was used to identify imports. This study made it possible to identify all imports entering the Province, either from other countries or from other provinces. The available published statistics identify imports entering from other countries but not other provinces thus, the Alberta Bureau of Statistics study was most useful. The figures for 1954 and 1957 were supplemented by published data to arrive at import flows for 1962. Some regression analysis was used to arrive at total volume of imports and this was checked by comparing regression analysis estimates for total consumption with actual figures for total consumption. When none of the above mentioned methods were available to arrive at import flows for particular sectors, imports were defined as total consumption minus total output, adjusted for any known exports. This method is very weak since only net imports (imports-exports) are usually obtained and as a result

was used only where no other method was available. Since output is valued in purchasers' prices no transportation charges needed to be allocated to imports.

Inventories

The inventory change shown for each industry represents the change in goods in process and finished goods inventory. Inventory changes of inputs or raw materials were not recorded, first because the changes appeared to be minimal and second, the difficulty of allocating the inventory accumulation or depletion to the producing industry was impossible to overcome. Thus inventory changes may be slightly understated. The inventory change was necessary to achieve a balance between consumption of output and total output for each sector.

Treatment of Capital Accounts

The inputs to a consuming industry represent transactions on current account only. Capital purchases are combined and shown in the primary input row for capital formation. As well, all government purchases were considered current account purchases.

It was necessary to include capital purchases in the primary input section because capital purchases in any given year are not likely to remain stable with respect to total output for that year.

Classification of Industries

All productive activities of the Alberta economy have been grouped into 34 sectors. As well there are 6 rows of primary input and 5 columns of final demand.

The 34 sectors fall into the following areas of broad classification:

1. Agricultural products (3 sectors)
2. Mineral products (2 sectors)
3. Agricultural processing (9 sectors)
4. Manufacturing (15 sectors)
5. Service (5 sectors)

In making the aggregation of firms into sectors three objectives were important:

1. Homogeniety of input structure
2. Homogeniety of output
3. Similar water inputs

The basic definitions of each sector will appear in the following section of this appendix.

Gross Domestic Output and Input

Gross domestic output of an industry is the total value of production of that plant, F.O.B. the plant plus the value of transportation used to deliver the goods to the purchaser or as in the case of exports to deliver the goods to the provincial border.

Gross domestic input is the sum of: (1) total consumption of domestically produced goods and services used to produce the output of the industry, (2) value added by the industry, and (3) the value of imported inputs. These various inputs are valued as landed at the plant of the purchasing industry.

Gross domestic output (total of rows) equals the gross domestic input (total of columns).

III. GENERAL ESTIMATION PROCEDURES

Since the model was derived by tracing the purchases of goods and services, the input structure of each sector was estimated. Generally the distribution of output was not measured except in instances where the output of a particular industry was not recorded as inputs or purchases of other industries (i.e. communication sector).

The total output figures for each sector may vary somewhat from published figures since some adjustments were made where double counting of output was apparent. The following are the most common adjustments:

1. Where no internal flows were given for an industry an arbitrary figure of ten thousand dollars was entered. This was necessary to insure that all elements of the main diagonal were none zero. (A necessary condition to calculate the inverse)

2. Since values in the table are in purchasers' prices transportation purchases were added to the output.

3. In cases where rents are paid in the form of shares of output it was believed that the output would be listed by both the rentor and the rentee. Thus the value of rents was subtracted from the total output value. This was most common in the agricultural sectors where landowners may share in the output in return for use of the land.

Agricultural Products

COMPOSITION

The agricultural products classification included three sectors of the Alberta Model. These sectors are defined as follows:

1. Field Crops: grains, animal feeds.
2. Fruits and Vegetables: all fruits and vegetables including potatoes and sugar beets.
3. Livestock and Animal Products: cattle, hogs, sheep and lambs, wool, chickens, eggs, turkey, other poultry, milk and cream.

OUTPUT

The output of each sector is given by individual components of each sector in Table XX. Output is defined as the sum of cash receipts from marketing, home consumption, inventory

TABLE XX

ESTIMATED PRODUCTION AND FARM VALUE OF AGRICULTURAL PRODUCTS FOR ALBERTA 1962[a]

	Thousands of dollars			
	Net output[b]	Less adjustments[c]	Transportation	Gross output
1 Field Crops	451,875	38,159	55,662	469,378
wheat	181,440			
oats	73,800			
barley	83,660			
rye	2,496			
tame hay	68,000			
misc.	42,479			
2 Fruits & Veg.	18,774	2,000	2,304	19,078
potatoes	5,580			
sugar beets	11,323			
misc.	1,871			
3 Livestock & Animal Products	335,719	3,515	22,236	354,440
cattle & calves	182,464			
sheep & lambs	2,692			
hogs	66,017			
dairy products	50,041			
poultry products	28,426			
misc.	6,079			

a) value delivered to purchaser

b) output F.O.B. farm

c) adjustments made for rents paid in products

change and outward transportation costs; less an adjustment for share rents paid. The adjustment was deemed necessary to eliminate double counting of output. Table XX was derived from - Estimated Production and Farm Value of Agricultural Products for Alberta 1962 - as calculated by the Farm Economics Branch of the Provincial Government.

INPUTS

The input structure for all three sectors was obtained from two sources:

1. A survey was conducted by the Farm Economics Branch to measure the accounts of farmers. This study was comprised of samples taken from each farm district. About 10 percent of farms were sampled. Input structures were approximated for each sector and adjusted to equal the value of output for the province in 1962.
2. Preliminary statistics on purchases made by agricultural sectors were found in the Interindustry Model of Canada, 1958 constructed by The Agricultural Research Council of Canada. These statistics gave the input structure for eleven agricultural sectors of Canada for 1958.

The figures obtained in (1) were supplemented by figures obtained in (2), where large differences existed or where there was insufficient data in (1).

Mineral Products

COMPOSITION

The mineral products classification comprised two sectors of the Alberta Model.

4. Mineral Products: all mining except petroleum.
5. Petroleum: natural gas and petroleum products.

OUTPUT

The two sectors comprising the mineral products classifications are defined on a product basis. The total output for each product is given in Table XXI.

INPUTS

The goods and services purchased by the mineral products sectors were identified by two means:

1. Purchases of goods and services for mineral industries in 1949 is given in the D.B.S. Reference Paper #29, Purchases of Capital Goods, Process Supplies and Specified Services by Canada's Mineral Industries, 1949. Although the figures given here are somewhat outdated they still provide basic guidelines to follow.
2. The figures given in 1 were supplemented by input coefficients given for the 1958 input-output model of the U.S.

TABLE XXI

ESTIMATED PRODUCTION OF MINERAL PRODUCTS, ALBERTA, 1962[a/]

	Thousands of dollars		
	Net output[b/]	Transportation	Gross output
4 Mineral Products	56,143	20,056	76,199
coal	9,970		
clay products	3,446		
sand & gravel	12,644		
stone	369		
salt	1,454		
sulphur	8,308		
industrial minerals	9,952		
5 Petroleum	504,647	77,947	582,594
natural gas	88,661		
natural gas by-products	36,156		
crude petroleum	379,830		

a) value delivered to purchaser

b) value F.O.B. well or mine

The input coefficients obtained from these sources were adjusted further by the use of statistics gathered by the Provincial Bureau of Statistics or the mining and petroleum industries.

Agricultural Processing

COMPOSITION

The agricultural processing classification included nine sectors of the Alberta model, defined as follows:

6. Meat Products: slaughtering and meat packing plants, poultry processors.
7. Processed Dairy: butter and cheese plants, pasturizing plants, condensaries, ice cream manufacturers, processed cheese manufacturers.
8. Fruit and Vegetable Preparation: fruit and vegetable canners and preservers.
9. Grain Mill Products: flour and meal, feed mills.
10. Bakery Products: bakeries.
11. Carbonated Beverages: soft drink manufacturers.
12. Alcoholic Beverages: breweries, distilleries.
13. Confectionary and Sugar Refining: confectionary manufacturers, sugar refineries.
14. Miscellaneous Food Products: animal oils and fats processors, biscuit manufacturers, breakfast cereal manufacturers, macaroni manufacturers, malt and malt products manufacturers, vegetable oil, milk, miscellaneous food manufacturers.

OUTPUT

The value of output for each sector of the agricultural processing classification is shown in Table XXII. Gross output is defined as the total value of production plus the inputed cost of transporting the goods to the final purchaser.

INPUTS

The input structure for each sector was estimated using the sampling methods discussed in Chapter II. The majority of inputs listed in the flow table were obtained from the sample, but where inadequacies existed the distribution of output of various producing sectors was traced. For example, no purchases from the communications sector were listed in the reports,therefore, purchases of communications had to be inputed.

Manufacturing

COMPOSITION

The manufacturing classified includes the production of all manufactured goods in Alberta. The detailed definitions of each sector's composition are as follows:

15. Leather and Textile Products: leather glove factories, leather tanneries, shoe factories, miscellaneous leather products manufacturers, canvas products industries, embroidery pleating and hemstiching manufacturers, cordage and twin industry, cotton and jute bag industry, synthetic textile mills, miscellaneous textile industries.

TABLE XXII

ESTIMATED PRODUCTION OF PROCESSED AGRICULTURAL GOODS, ALBERTA, 1962

	Thousands of dollars		
	Net output[a]	Transportation	Gross output[b]
6 Meat Products	229,097	8,775	237,872
slaughtering	218,480		
poultry processors	10,617		
7 Processed Dairy	63,902	8,248	72,150
butter & cheese plants	23,828		
pasturizing plants	33,548		
misc.	6,526		
8 Fruit & Vegetable Processors	5,570	320	5,890
9 Grain Mill Products	47,193	4,135	51,328
feed mills	15,326		
flour mills	31,867		
10 Bakery Products	19,486	3,746	23,232
11 Carbonated Beverages	8,410	3,851	12,261
12 Alcoholic Beverages	24,807	2,049	26,856
breweries	23,073		
distilleries	1,734		
13 Confectionary & Sugar	12,086	1,110	13,196
confectionary	191		
sugar refineries	11,895		
14 Miscellaneous Foods	14,792	190	14,982

a) value of production F.O.B. producing plant

b) value of production delivered to purchaser

16. Clothing: knitting mills, mens clothing factories, womens clothing factories, fur goods industry, hat and cap industry.

17. Forestry and Wood Products: forest products, veneer and plywood mills, sawmills, sash and door and planing mills, coffin and casket industry, miscellaneous wood products industries (including wooden box factories, woodenware, wood preservation), household furniture industry, other furniture industries.

18. Paper Products: pulp and paper mills, asphalt roofing manufacturers, paper box and bag manufacturers, miscellaneous paper converters.

19. Printing and Publishing: printing and book-binding, lithographing, engraving, stereotyping and allied industries, printing and publishing.

20. Primary Metals: aluminum rolling, casting and extruding mills, iron foundries, iron and steel mills, metal rolling, casting and extruding mills, smelting and refining mills, steel pipe and tube mills.

21. Metal Fabricating: boiler and plate works, fabricated structural metal industry, ornamental and architectural metal industry, metal stamping, pressing and coating industry, wire and wire products manufacturers, heating equipment manufacturers, machine shops, hardward tool and cutlery manufacturers, miscellaneous metal fabricating industries.

22. Machinery Industries: agricultural implements industry, miscellaneous machinery and equipment manufacturers.

23. Transportation Equipment Industries: aircraft and parts manufacturers, truck body and trailer manufacturers, motor vehicle parts and accessories manufacturers, railway rolling stock industry, boat building and repairs industry, miscellaneous vehicle manufacturers.

24. Electrical Products Industries: battery manufacturers, communication equipment manufacturers, manufacturers of electrical industrial equipment, manufacturers of miscellaneous electrical products.

25. Non-Metallic Mineral Products: cement manufacturers, concrete products manufacturers, ready-mix concrete manufacturers, mineral wool manufacturers, glass and glass products manufacturers, lime manufacturers, gypsum products manufacturers, miscellaneous non-metallic mineral products industries.

26. Petroleum and Coal Products: petroleum refining, manufacturers of lubricating oils and greases, miscellaneous petroleum and coal products industries.

27. Chemical Products: manufacturers of plastics and synthetic resins, manufacturers of soaps and cleaning compounds, manufacturers of industrial chemicals, explosives and ammunition manufacturers, manufacturers of pharmaceuticals and medicines, manufacturers of printing inks, paint and varnish manufacturers, miscellaneous chemical manufacturers.

28. Rubber Products: rubber tire and tube manufacturers, miscellaneous rubber goods manufacturers.

29. Miscellaneous Manufacturing: scientific and professional equipment manufacturers, plastic fabricators, signs and display industry, stamp and stencil manufacturers, sporting goods industries, miscellaneous industries.

OUTPUT

The gross output for each sector is given in table XXIII. Output levels were obtained directly from the Provincial Bureau of Statistics.

INPUTS

The input structure for each sector was estimated using the sample survey. Thus all comments made for the agricultural processing classification apply here as well.

TABLE XXIII

ESTIMATED PRODUCTION OF MANUFACTURED PRODUCTS, ALBERTA, 1962

	Thousands of dollars		
	Net output[a]	Transportation	Gross output[b]
15 Leather & Textiles	9,538	674	10,212
leather products	1,180		
canvas products	815		
textile products	7,543		
16 Clothing	15,143	110	15,253
men's clothing	12,895		
women's clothing	2,248		
17 Forestry & Wood Products	80,788	9,009	89,797
sawmills	19,832		
planing mills	20,369		
furniture	9,674		
forest products	25,400		
misc.	5,513		
18 Paper Products	37,100	2,179	39,279
19 Printing & Publishing	32,113	610	32,723
printing & bookbinding	5,763		
lithography	3,144		
printing & publishing	20,687		
misc.	2,519		
20 Primary Metals	40,606	3,719	44,325
21 Metal Fabricating	57,772	4,228	62,000
boilers & plate works	5,892		
fabricated metals	18,321		
machine shops	10,731		
misc.	22,828		
22 Machinery Industries	10,297	595	10,892
agricultural implements	3,156		
misc.	7,141		
23 Transportation Equipment	30,967	294	31,261
truck body & trailer	4,650		
motor vehicle parts	1,906		
misc.	24,411		
24 Electrical Products	7,956	130	8,086
electrical industrial equip.	1,463		
misc.	6,493		
25 Non-Metallic Minerals	69,810	15,513	85,323
cement manufacturers	15,246		
concrete products	15,119		
ready-mix concrete	14,823		
glass products	10,863		
misc.	13,579		

TABLE XXIII (continued)

	Thousands of dollars		
	Net output	Transportation	Gross output
26 Petroleum & Coal Products	111,773	35,090	146,863
petroleum refining	111,140		
misc.	633		
27 Chemical Products	70,200	7,707	77,907
plastics & synthetics	18,126		
industrial chemicals	745		
soaps & cleaners	45,052		
misc.	6,277		
28 Rubber Products	11,227	563	11,790
29 Miscellaneous Manufacturing	7,331	440	7,771
dental labs	1,135		
plastics	1,589		
signs & displays	2,882		
misc.	1,725		

a) value of production F.O.B. producing plant

b) value of production delivered to purchaser

Services

The service classification included five sectors of the Alberta model. Since estimation techniques varied for each sector, the sectors will be discussed individually.

COMPOSITION

The service classification included the following five sectors:

30. Utilities: electric light and power, natural, manufactured and liquified petroleum gas.
31. Transportation and Storage: railroads, trucking, warehousing and storage, air transportation, pipeline transportation.
32. Service: food and beverage establishments, hotels and camps, laundries and dry cleaners, other personal services, business services, auto repair shops, other repair services, motion picture theaters, other amusements retail and wholesale trade.
33. Communications: telephone and telegraph, radio and T.V. broadcasting.
34. Unallocated: banking and finance, real estate and rentals, medical and dental services, nonprofit institutions (including education), advertising, other unspecified inputs.

OUTPUT

The gross output values for each sector of the service classification are shown in Table XXIV. There are no apparent statistics available for the change in inventory for the sectors of this classification and thus it was assumed that inventory did not change. Since the value of output for each sector was

TABLE XXIV

ESTIMATED OUTPUT OF THE SERVICE SECTORS, ALBERTA, 1962

	Thousands of dollars		
	Net output[a]	Transportation	Gross output[b]
30 Utilities	102,228	5,610	107,838
electricity	62,373		
natural gas	39,855		
31 Transportation	394,821	4,727	399,548
rail transportation	121,744		
truck & bus	168,660		
warehousing	1,633		
pipeline	73,005		
misc. (including air)	29,779		
32 Service	708,427	7,800	717,227
wholesale trade	238,268		
retail trade	203,120		
amusements	16,993		
business services	17,553		
hotels, restuarants, etc.	134,974		
misc. services	69,056		
personal services	28,463		
33 Communications	85,114	4,000	89,114
radio & T.V.	16,514		
telegraph	6,222		
postal	15,690		
telephone	46,688		
34 Unallocated[c]	1,043,663	11,000	1,054,663

a) value of output F.O.B. producer

b) value of output delivered to purchaser

c) Accurate figures are not available for each component of the unallocated sector.

arrived at through different means the sectors will each be discussed.

30. Utilities

The value of output shown in Table XXIV was obtained from the following D.B.S. publications for 1962:

1. Telephone Statistics (#56-203)
2. Electric Power Statistics (#57-202)

31. Transportation

The value of output for the transportation sector is defined as the total receipts for all forms of transportation of goods and services. The output values for Alberta are given in the following D.B.S. publications:

1. Railway Freight Traffic (#52-205)
2. Air Pipeline Transportation (#55-201)
3. Civil Aviation (#51-201)
4. Motor Transport Traffic Quarterly (#53-004)
5. Motor Carriers Freight Pts. I & II (#53-222) (#53-223)

32. Service

The service sector is defined to include the gross profit margin in all goods sold by retail and wholesale trade and the gross value of all services rendered.

The value of output for components of the service sector and the total value of goods and services sold by wholesale and retail trade were reported in Census of Canada - Service Trades, 1961. The gross margins for retail trade and wholesale trade were calculated by multiplying the percent margins (24.33 for retail trade and 17.98 for wholesale trade) reported in Taxation Statistics 1964 (figures for 1962) by the total value of goods sold.

33. Communications

The gross output for the communications sector is defined as the total revenue derived from advertising and services rendered for each component of the sector. Output values are found in the following D.B.S. publications:

1. Telephone Statistics (#56-203)
2. Telegraph and Cable Statistics (#56-201)
3. Radio and Television Broadcasting
4. Figures for C.B.C. operation were estimated as revenue per capita for Canada and this figure was adjusted for the population of Alberta.

34. Unallocated

The gross value of output is defined as the total revenue for services rendered plus expenditures for medical and educational services in the province. The value of output was found from the following sources:

1. Estimations for rent, insurance, interest and advertising costs were reported in Taxation Statistics 1964.
2. The value of unallocated inputs purchased by the food processing and manufacturing sectors was found from the sample survey.
3. Estimated expenditures for medical and educational services were reported in Canada Year Book 1963.

DISTRIBUTION OF OUTPUT

Very little data was available for expenditures on the service trades by each sector of the economy. Thus it was necessary to obtain the distribution of output for each sector in the service classification in an attempt to complete the entries in each column. The distribution of output was mainly found from the sources listed for output totals. Where sales by each service sector to each purchasing sector were not given, the Canadian input-output model for 1949, and the American model for 1958 were used to estimate the column and row entries.

INPUTS

The tracing of inputs followed the same procedure as the tracing of output for the service sectors. The above-mentioned sources for output values frequently gave general classifications of purchases. The general information was supplemented with data derived from input coefficients of the Canadian and American models. Since the Canadian model gives

values in purchasers' prices it was more useful. Adjustments in transportation had to be made for entries derived from the American model.

Exogenous Sectors

COMPOSITION

The exogenous section of the model was comprised of five final demand columns and six primary input rows. The detailed definitions of each row and column are given below.

Final Demand

35. Construction: includes purchases made by the construction industry required to meet the level of maintenance and new construction in Alberta in 1962.

36. Capital Formation: includes all inventory depletion and accumulation of producing sectors plus all capital expenditures on machinery and new construction.

37. Government: includes the purchases from all sectors of the economy made by federal, provincial and municipal governments in Alberta.

38. Households: includes the personal expenditures on goods and services in Alberta. Total expenditure equals personal consumption expenditure as estimated by The Dominion Bureau of Statistics.

39. Exports: includes all exports of goods and services to other provinces and countries.

Primary Inputs

35. Construction: includes expenditures for all maintenance work done by contractors and that done by employees of the producing industry. New construction is entered as the flow in the capital formation column. New construction is defined as the design and erection of immobile

structures and utilities plus those service facilities that become an integral part of the structure.

36. Capital Formation: row entries include the depreciation allowance on buildings and equipment made by each sector.

37. Government: outputs are the services rendered by federal, provincial and municipal governments as measured by the amount of taxes paid by each sector of the economy.

38. Households: flows to other sectors are in the form of wages, salaries and income from unincorporated businesses.

39. Imports: includes purchases of imported goods by each sector of the economy.

40. Corporate Profits: includes after tax profits earned by corporations.

OUTPUT

Since the value of output for each row represents many estimations and data sources they will be discussed individually.

35. Construction

The value of construction in Alberta for 1962 is reported by the Provincial Bureau of Statistics and includes: (1) the total value of permits taken out for construction projects, (2) estimations of revenue earned by repair contractors, and (3) estimates of own account construction done by the producing sectors of the economy. The value of construction for 1962 is shown in Table XXV.

36. Capital Formation

Estimates of depreciation allowances were found in

TABLE XXV

ESTIMATED VALUE OF CONSTRUCTION IN ALBERTA, 1962

Type of construction	Thousands of dollars		
	New construction[a/]	Repair construction	Total construction
Total Value of Construction	652,989	167,220	820,209
Total Building Construction	370,909	92,459	463,368
Residential	173,600	55,900	229,500
Industrial	13,755	5,815	19,570
Commercial	46,533	12,146	58,679
Institutional	85,216	6,577	91,793
Misc. building	51,805	12,021	63,826
Total Engineering Construction	282,080	74,761	356,841
Roads & highway	65,298	29,080	94,378
Water works & sewage	14,368	3,841	18,209
Dams & irrigation	7,940	1,206	9,146
Electric power	18,792	3,424	22,216
Railway, telegraph	18,360	14,101	32,461
Misc. engineering	12,587	8,157	20,744

a) All government purchases are considered current account; thus in model, no government construction is considered as capital accumulation.

b) Includes erection of oil and gas wells.

Taxation Statistics 1964. Since D.B.S. used similar classifications to those in the Alberta model depreciation allowances were entered directly on the flow table.

37. Government

Values of taxes paid by each sector were also found in Taxation Statistics 1964. Personal income tax figures were used as the entry in column 38. The total output of the government row was found by the following method:

1. Provincial Government revenues were report in Public Accounts, Alberta 1963.
2. Federal Government revenue or expenditures was reported in Canada Year Book 1963, as total expenditures for Canada. These were reduced to a per capita basis and then adjusted to reflect expenditures in Alberta.
3. As with federal government expenditures municipal expenditures were given for all of Canada in Canada Year Book 1963. These were adjusted for the population of Alberta as above.

The total expenditures by all levels of government was assumed to equal the total revenue. This was a limiting, but necessary assumption given the available data. The total expenditures for each level of government are shown in Table XXVI.

38. Households

Entries for wages and salaries for each column were found in the estimated input structures. Income from unincorporated businesses was estimated for all sectors and was found to be significant only for sectors 1, 3, 31, 32 and 34. The components

TABLE XXVI

ESTIMATED EXPENDITURES ON GOODS AND SERVICES BY FEDERAL, MUNICIPAL AND PROVINCIAL GOVERNMENTS IN ALBERTA, 1962

Level of Government	Expenditures[a] (thousands of dollars)
Total Government Expenditures	609,336
Government of Alberta	263,854
Government of Canada[b]	175,107
Municipal Governments	170,375

a) adjusted to omit transfer payments

b) Includes military spending, but not the operation of post offices and crown corporations.

of disposable personal income are given in Table XXVII. Government transfer payments are omitted in the calculation of personal income.

39. Imports

The total values of exports and imports are given in Table XXVIII. The value of exports and imports are given in Table XXVIII. The value of imports and exports for 1962 was estimated using an Alberta Bureau of Statistics study of flows to and from other provinces and countries. This study was conducted by examining the reports of all common and railway carriers listing origin and destination of all goods. Although this study was done for the years 1949, 1954 and 1957 it was assumed that 1962 flows were similar to those in 1957. When available data suggested errors in import or export figures, adjustments were made. The treatment of imports is also discussed in Section I of this chapter.

40. Profit

Estimations of profits earned by corporations are given in Taxation Statistics, 1964. These figures were adjusted to reflect Alberta production levels and entered in the model.

INPUTS

The total revenue of the row sectors was assumed to be equal to the total expenditures of the column sector in sectors

TABLE XXVII

COMPONENTS OF PERSONAL INCOME, ALBERTA, 1962[a]

Component	Income (thousands of dollars)
Wages, salaries and supplimentary labor income	1,374,000
Net income received by farm operators	270,000
Net income of non-farm unincorporated businesses	207,000
Interest, dividends and net rental income	202,000
Total personal income	2,053,000

a) Government transfer payments are omitted.

TABLE XXVIII

ESTIMATED VALUE OF EXPORTS AND IMPORTS BY SECTOR CLASSIFICATION, ALBERTA, 1962

Sector Number	Sector Classification	Thousands of dollars	
		Exports	Imports a/
1	Field Crops	315,797	-
2	Vegetables & Fruit	6,179	14,533
3	Livestock & Animal Products	64,290	-
4	Mineral Products	26,191	8,877
5	Petroleum	488,323	6,390
6	Meat Products	107,034	490
7	Processed Dairy Products	18,629	3,507
8	Fruit & Veg. Prep.	1,817	13,164
9	Grain Mill Products	14,318	629
10	Bakery Products	-	9,000
11	Carbonated Beverages	276	-
12	Alcoholic Beverages	-	12,896
13	Confectionary & Sugar Refining	3,381	20,475
14	Miscellaneous Food Products	4,516	16,144
15	Leather & Textile Products	2,764	36,798
16	Clothing	-	141,591
17	Forestry & Wood Products	12,018	99,771
18	Paper Products	8,166	31,745
19	Printing & Publishing	136	8,713
20	Primary Metals	9,032	25,814
21	Metal Fabricating	3,145	111,197
22	Machinery Industries	-	182,778
23	Transportation Equipment	1,973	130,976
24	Electrical Products	-	129,839
25	Non-Metallic Mineral Products	1,761	19,989
26	Petroleum & Coal Products	18,353	1,138
27	Chemical Products	12,728	53,445
28	Rubber Products	-	17,794
29	Miscellaneous Manufacturing	-	19,375
30	Utilities	-	5,354
31	Transportation	2,180	-

a/ Imports of product type listed on the left

35, 37 and 38. The sum of the output of rows 36, 39 and 40 was equal to the sum of the expenditures of columns 36 and 39. The pattern of expenditures for each column sector is given as follows:

35. Construction

The expenditures on goods and services by the construction industry were estimated from input coefficient of the American model for 1958 and the Canadian model for 1949. It was assumed that inputs to the construction industry are generally standardized throughout North America. This is a weak approach, but a general study of purchases by the construction industry in Alberta is the only alternative solution.

36. Capital Formation

Inventory accumulations and depletions were given in the reports sampled for the agricultural processing and manufacturing industries. Estimates of inventory changes for the agricultural sectors were made by placing a value on the changes in units of animals, grain, etc. for each sector. The change in inventories are shown in Table XXIX. The totals for capital expenditures were obtained from National Accounts. The gross figures were then allocated to the producing sectors of the Alberta economy on the basis of total invested capital. The Canadian model was used as a guide in the allocation procedure.

TABLE XXIX

ESTIMATED INVENTORY CHANGE FOR SECTORS OF THE ALBERTA ECONOMY, 1962

Sector Number	Sector a/	Inventory Change b/ thousands of dollars
1	Field Crops	13,124
2	Vegetables & Fruit	(1)
3	Livestock & Animal Products	2,070
4	Mineral Products	-
5	Petroleum	-
6	Meat Products	(619)
7	Processed Dairy Products	294
8	Fruit & Veg. Prep.	411
9	Grain Mill Products	(3)
10	Bakery Products	102
11	Carbonated Beverages	36
12	Alcoholic Beverages	198
13	Confectionary & Sugar Refining	2,874
14	Miscellaneous Food Products	1,345
15	Leather & Textile Products	147
16	Clothing	333
17	Forestry & Wood Products	(122)
18	Paper Products	(503)
19	Printing & Publishing	225
20	Primary Metals	6,607
21	Metal Fabricating	(245)
22	Machinery Industries	751
23	Transportation Equipment	332
24	Electrical Products	1,534
25	Non-Metallic Mineral Products	(476)
26	Petroleum & Coal Products	(339)
27	Chemical Products	(314)
28	Rubber Products	244
29	Miscellaneous Manufacturing	64

a/ The inventory was assumed to remain unchanged for sectors 30 through 40

b/ Change in inventory of finished goods and goods in process

37. Government

The detailed expenditures on goods and services for the Province of Alberta are reported in Public Account, Alberta 1963. Expenditures for the Federal and Municipal Governments were estimated using the figures for the Provincial Government and the expenditures reported in the Canadian model.

38. Households

The average expenditures for urban families in Alberta were reported in Urban Family Expenditures 1959. (#62-521) Since these are expenditures for urban families only, some adjustments were made for farm families using information in Handbook of Agricultural Statistics. Purchases from the service sector were estimated by reducing each purchase of goods sold by retail trade establishments by a percent margin (24.33%). The sum of the adjustments was entered as a purchase from the service sector. Purchases of other personal services were given in Urban Family Expenditures 1959.

All purchases were then adjusted to equal total personal income for 1962.

39. Exports

The value of exports for each sector is given in Table XXVIII. The value of exports of each commodity was estimated using the methods described for estimating imports.

APPENDIX C

BASIC INPUT-OUTPUT TABLES, MODEL I

	In
.	Field
.	Veget
.	Lives
.	Miner
.	Petro
.	Meat
.	Proce
.	Fruit
.	Grain
.	Baker
.	Carbo
.	Alcoh
.	Confe
.	Miscel
.	Leath
.	Cloth
.	Forest
.	Paper
.	Print
.	Prima
.	Metal
.	Machi
.	Trans
.	Elect
.	Non-M
.	Petrol
.	Chemic
.	Rubbe
.	Miscel
	Utilit
	Transp
	Servic
	Commu
	Unall
	Const
	Capita
	Govern
	Househ
	Import
	Corpo
	Tot

TABLE XXX

INTERINDUSTRY FLOW OF GOODS AND SERVICES, ALBERTA, 1962

(Thousands of dollars)

Industry Producing	Industry Purchasing																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Field Crops	21,016	-	75,558	-	-	-	-	-	35,090	-	-	2,348	-	6,444	-	-	-	-	-	-	-	-	-
2. Vegetables & Fruit	-	91	-	-	-	71	-	1,267	-	-	-	-	6,824	50	-	-	-	-	-	-	-	-	-
3. Livestock & Animal Products	-	-	87,320	-	-	159,174	39,869	-	164	-	-	-	-	29	-	-	-	-	-	-	-	-	-
4. Mineral Products	-	-	-	880	3,675	223	-	11	25	-	-	25	179	4	-	-	-	705	-	7,666	4	-	1
5. Petroleum	-	-	-	-	11,452	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6. Meat Products	-	-	-	-	-	6,955	-	22	1,270	-	-	-	-	-	570	-	-	-	-	-	-	-	-
7. Processed Dairy Products	-	-	-	-	-	182	2,182	7	-	-	-	-	-	45	-	-	57	-	-	-	-	-	-
8. Fruit & Veg. Prep.	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9. Grain Mill Products	9,006	100	10,402	-	-	18	-	2	10	8,529	-	-	-	587	-	-	-	-	-	-	-	-	-
10. Bakery Products	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
11. Carbonated Beverages	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-
12. Alcoholic Beverages	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-	-	-	-	-	-	-	-	-
13. Confectionary & Sugar Refining	-	-	-	-	-	128	260	21	-	-	528	65	10	128	-	-	-	-	-	-	-	-	-
14. Miscellaneous Food Products	-	-	-	-	-	930	50	37	-	-	240	14	15	728	28	-	-	35	-	-	-	-	-
15. Leather & Textile Products	-	-	-	2	-	-	-	-	523	-	-	-	-	-	887	2,334	-	703	-	-	10	-	2
16. Clothing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	1,404	-	-	-	-	-	-
17. Forestry & Wood Products	4,500	-	1,667	579	2,073	-	992	-	-	-	-	44	-	-	-	-	10,135	6,564	-	2	290	17	580
18. Paper Products	-	-	-	430	202	3,195	750	168	649	395	-	693	-	-	2	-	103	1,989	341	-	-	-	65
19. Printing & Publishing	20	-	12	24	139	96	64	96	150	100	100	60	70	70	-	150	-	200	2,400	-	100	-	-
20. Primary Metals	-	-	-	620	1,479	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,962	6,485	3,050	2,015
21. Metal Fabricating	-	-	-	249	14,944	-	-	299	-	-	122	129	6	-	1	-	771	17	20	68	1,311	383	3,017
22. Machinery Industries	1,400	120	500	21	2,654	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-
23. Transportation Equipment	3,201	324	734	1,551	4,787	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
24. Electrical Products	-	-	-	55	708	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44
25. Non-Metallic Mineral Products	1,500	-	980	2,749	1,853	-	-	107	-	-	139	131	-	-	-	-	349	75	-	343	404	-	-
26. Petroleum & Coal Products	15,371	176	2,072	2,130	3,460	-	6	-	25	-	-	-	39	19	146	-	185	445	-	7	6	9	12
27. Chemical Products	12,841	413	1,110	523	5,199	894	-	41	508	422	61	31	3	94	2,153	-	649	2,196	248	1,667	152	42	445
28. Rubber Products	250	-	190	878	1,077	-	-	-	-	-	-	-	-	-	-	-	186	6	-	-	-	69	27
29. Miscellaneous Manufacturing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	122	19	-	-	39	-	-
30. Utilities	4,025	137	2,014	1,843	3,721	785	537	79	317	169	68	249	233	242	100	29	1,020	1,360	150	1,160	279	93	241
31. Transportation	55,662	2,304	22,236	20,056	77,947	8,775	8,248	320	4,135	3,746	3,851	2,049	1,110	190	674	110	9,009	2,179	610	3,719	4,228	595	294
32. Services	9,917	93	4,007	3,657	17,618	490	392	129	692	2,100	132	625	165	290	165	746	2,600	199	1,200	700	1,900	165	38
33. Communications	603	119	403	127	413	373	160	92	310	91	62	179	162	68	163	130	230	280	2,100	310	220	80	160
34. Unallocated	58,094	5,246	4,565	3,037	80,381	5,391	2,740	91	1,131	458	2,447	3,112	1,353	2,034	1,003	2,674	5,523	7,306	3,314	9,312	10,135	405	3,096
Construction	6,204	526	3,995	274	12,875	1,096	600	500	650	700	75	130	50	25	-	-	800	360	75	550	800	300	150
Capital Formation	49,131	3,345	20,426	3,660	58,340	11,563	1,371	118	490	678	445	762	428	342	231	119	2,623	1,919	1,038	3,235	2,255	300	651
Government	46,472	2,373	23,745	4,138	68,958	1,421	832	91	563	425	845	10,300	556	576	176	134	1,825	1,929	647	1,122	1,797	432	1,435
Households	151,414	4,811	88,503	17,500	102,148	19,948	9,697	1,023	2,628	3,811	1,226	2,830	1,451	1,375	1,871	3,257	33,434	4,943	9,362	7,391	16,151	2,516	12,143
Imports	18,751	-	3,999	6,282	49,375	3,855	1,901	1,209	1,131	999	1,291	1,005	9	876	1,702	5,198	15,402	2,923	8,427	2,350	11,835	1,844	5,228
Corporate Profit	-	-	-	2,201	59,122	12,309	1,499	150	867	599	619	2,050	533	767	340	362	3,370	2,927	2,791	1,761	3,599	582	1,607
Total	469,378	19,078	354,440	76,199	582,594	237,872	72,150	5,890	51,328	23,232	12,261	26,856	13,196	14,982	10,212	15,253	89,797	39,279	32,723	44,325	62,000	10,892	31,261

(Components may not add exactly to totals because of rounding)

TABLE XXX

TERINDUSTRY FLOW OF GOODS AND SERVICES, ALBERTA, 1962

(Thousands of dollars)

Industry Purchasing																				Final Demand					Gross Outpu
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	Construction	Formation	Government	Households	Exports	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13,124	-	-	315,797	469,37
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95	-	-	-	1	-	4,500	6,179	19,07
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,070	24	1,500	64,290	354,44
-	-	-	705	-	7,666	4	-	1	-	25,133	182	3,862	25	-	-	480	-	-	-	4,899	-	-	2,029	26,191	76,19
-	-	-	-	-	-	-	-	-	-	-	64,529	2,024	-	-	13,243	-	-	-	-	3,023	-	-	-	488,323	582,59
570	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	105	125	-	1,558	-	(619)	429	120,422	107,034	237,87
-	-	57	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	520	-	294	263	49,946	18,629	72,15
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95	-	405	-	411	-	3,152	1,817	5,89
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	102	-	(3)	-	8,257	14,318	51,32
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	125	-	102	-	22,995	-	23,23
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	162	-	36	160	11,617	276	12,26
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-	-	198	-	26,533	-	26,85
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	-	-	-	2,874	85	5,636	3,381	13,19
28	-	-	35	-	-	-	-	-	-	-	-	39	-	-	-	76	25	-	-	-	1,345	152	6,752	4,516	14,982
887	2,334	-	703	-	-	10	-	2	-	55	-	225	626	-	-	-	396	-	-	150	147	-	1,388	2,764	10,212
-	10	1,404	-	-	-	-	-	-	-	-	-	-	-	-	-	-	120	-	-	-	333	937	12,449	-	15,253
-	-	10,135	6,564	-	2	290	17	580	-	698	-	3,188	-	-	200	2,800	2,500	319	-	24,875	(122)	5,192	10,686	12,018	89,797
2	-	103	1,989	341	-	-	-	65	72	1,403	-	1,277	14	-	-	-	1,321	-	292	13,937	(503)	2,283	2,035	8,166	39,279
-	150	-	200	2,400	-	100	-	-	-	-	98	150	-	-	200	3,100	4,000	650	4,700	549	225	5,873	9,101	136	32,723
-	-	-	-	-	2,962	6,485	3,050	2,015	583	-	-	-	-	-	-	3,796	-	-	286	7,410	6,607	-	-	9,032	44,325
1	-	771	17	20	68	1,311	383	3,017	53	718	-	20	37	-	-	3,579	447	-	525	27,384	4,755	-	-	3,145	62,000
-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	4,400	-	-	-	750	1,893	1,142	-	-	10,892
-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	1,900	124	-	-	2,267	7,890	3,840	2,660	1,973	31,261
-	-	-	-	-	-	-	-	44	24	-	-	-	-	-	250	40	60	180	-	2,623	2,094	670	1,338	-	8,086
-	-	349	75	-	343	404	-	-	-	4,112	447	706	-	24	-	-	-	-	-	65,556	(476)	3,692	871	1,761	85,323
146	-	185	445	-	7	6	9	12	-	-	36	9	-	-	241	32,475	-	-	2,386	9,605	(339)	7,900	52,089	18,353	146,863
2,153	-	649	2,196	248	1,667	152	42	445	170	468	2,322	4,455	339	285	120	3,738	-	-	2,630	5,071	(314)	360	15,843	12,726	77,907
-	-	186	6	-	-	-	69	27	147	-	-	-	565	-	-	700	-	-	-	1,732	244	260	5,459	-	11,790
-	-	122	19	-	-	39	-	-	103	-	-	39	25	63	-	-	-	-	250	518	64	-	6,529	-	7,771
100	29	1,020	1,360	150	1,160	279	93	241	72	2,419	1,629	3,619	176	65	4,705	520	18,820	813	13,206	1,640	-	5,616	35,687	-	107,838
674	110	9,009	2,179	610	3,719	4,228	595	294	130	15,513	35,090	7,707	563	440	5,610	4,727	7,800	4,000	11,000	6,808	-	22,199	43,734	2,180	399,548
165	746	2,600	199	1,200	700	1,900	165	38	96	960	2,600	2,200	390	439	3,500	16,570	85,255	1,300	81,524	28,391	-	53,110	393,327	-	717,227
163	130	230	280	2,100	310	220	80	160	160	200	900	800	125	316	450	2,300	13,500	1,247	12,731	1,505	-	3,020	45,025	-	89,114
1,003	2,674	5,523	7,306	3,314	9,312	10,135	405	3,096	2,011	3,146	2,938	18,246	1,544	3,457	5,801	65,054	127,721	13,943	69,530	35,169	-	127,060	366,195	-	1054,663
-	-	800	360	75	550	800	300	150	130	195	3,347	475	85	35	6,699	16,191	11,154	2,890	10,664	780	622,177	114,687	-	-	820,209
231	119	2,623	1,919	1,038	3,235	2,255	300	651	219	3,581	4,930	3,093	372	176	10,988	59,966	61,615	7,672	72,894	64,450	-	-	59,102	-	-
176	134	1,825	1,929	647	1,122	1,797	432	1,435	309	2,451	6,920	3,796	513	220	13,767	32,384	44,355	6,188	65,981	13,477	-	737	249,446	-	609,336
1,871	3,257	33,434	4,943	9,362	7,391	16,151	2,516	12,143	910	13,737	7,211	10,637	1,568	1,642	18,374	98,418	287,134	42,081	633,939	259,729	-	167,314	10,863	-	2053,000
1,702	5,198	15,402	2,923	8,427	2,350	11,835	1,844	5,228	2,649	6,163	10,138	6,384	4,493	227	751	15,124	11,905	1,299	5,842	183,674	179,997	82,330	465,854	-	1122,422
340	362	3,370	2,927	2,791	1,761	3,599	582	1,607	248	4,402	3,546	4,956	330	382	22,939	30,980	37,580	6,532	63,409	54,237	-	-	-	-	327,596
10,212	15,253	89,797	39,279	32,723	44,325	62,000	10,892	31,261	8,086	85,323	146,863	77,907	11,790	7,771	107,838	399,548	717,227	89,114	1054,663	820,209	844,506	609,336	2053,000	1123,005	10445,089

nts may not add exactly to totals because of rounding)

TABLE XXXI

INTERINDUSTRY TRANSACTIONS, ALBERTA, 1962, DIRECT PURCHASES PER DOLLAR OF OUTPUT

	Industry Purchasing																								
Industry Producing	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Field Crops	.04477	-	.21318	-	-	-	-	-	.68364	-	-	.08743	-	.43012	-	-	-	-	-	-	-	-	-	-	-
2. Vegetables & Fruit	-	.00477	-	-	-	.00030	-	.21511	-	-	-	-	.51713	.00334	-	-	-	-	-	-	-	-	-	-	-
3. Livestock & Animal Products	-	-	.24636	-	-	.66916	.55258	-	.00320	-	-	-	-	.00194	-	-	-	-	-	-	-	-	-	-	-
4. Mineral Products	-	-	-	.01155	.00631	.00094	-	.00187	.00049	-	-	.00093	.01356	.00027	-	-	-	.01795	-	.17295	.00006	-	.00003	-	.29456
5. Petroleum	-	-	-	-	.01966	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6. Meat Products	-	-	-	-	-	.02924	-	.00374	.02474	-	-	-	-	-	.00582	-	-	-	-	-	-	-	-	-	-
7. Processed Dairy Products	-	-	-	-	-	.00077	.03024	.00119	-	-	-	-	-	.00300	-	-	.00063	-	-	-	-	-	-	-	-
8. Fruit & Veg. Prep	-	-	-	-	-	-	-	.00170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9. Grain Mill Products	.01919	.00524	.02935	-	-	.00008	.00034	-	.00019	.36713	-	-	-	.03918	-	-	-	-	-	-	-	-	-	-	-
10. Bakery Products	-	-	-	-	-	-	-	-	-	.00043	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11. Carbonated Beverages	-	-	-	-	-	-	-	-	-	-	.00082	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12. Alcoholic Beverages	-	-	-	-	-	-	-	-	-	-	-	.00093	-	-	-	-	-	-	-	-	-	-	-	-	-
13. Confectionary & Sugar Refining	-	-	-	-	-	.00054	.00360	.00357	-	-	.04306	.00242	.00076	.00854	-	-	-	-	-	-	-	-	-	-	-
14. Miscellaneous Food Products	-	-	-	-	-	.00391	.00069	.00628	-	-	.01957	.00052	.00114	.04859	.00274	-	-	.00089	-	-	-	-	-	-	-
15. Leather & Textile Products	-	-	-	.00003	-	-	-	-	.01019	-	-	-	-	-	.08686	.15302	-	.01790	-	-	.00016	-	.00006	-	.00064
16. Clothing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00066	.01564	-	-	-	-	-	-	-	-
17. Forestry & Wood Products	.00959	-	.00470	.00760	.00356	-	.01375	-	-	-	-	.00164	-	-	-	-	.11287	.16711	-	.00005	.00468	.00156	.01855	-	.00818
18. Paper Products	.00004	-	-	.00564	.00035	.01343	.01040	.02852	.01264	.01700	-	.02580	-	-	.00020	-	.00115	.05064	.01042	-	-	-	.00208	.00890	.01644
19. Printing & Publishing	-	-	.00003	.00031	.00024	.00040	.00089	.01630	.00292	.00430	.00816	.00223	.00530	.00467	-	.00983	-	.00509	.07332	-	.00161	-	-	-	-
20. Primary Metals	-	-	-	.00814	.00254	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.06682	.10460	.28002	.06446	.07210	-
21. Metal Fabricating	-	-	-	.00327	.02565	-	-	.05076	-	-	.00995	.00480	.00045	-	.00010	-	.00859	.00043	.00061	.00153	.02115	.03516	.09651	.00655	.00842
22. Machinery Industries	.00298	.00629	.00141	.00028	.00112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00092	-	-	-
23. Transportation Equipment	.00682	.01698	.00207	.02035	.00082	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00032	-	-
24. Electrical Products	-	-	-	.00072	.00122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00141	.00297	-
25. Non-Metallic Mineral Products	.00320	-	.00277	.03608	.00318	-	-	.01817	-	-	.00134	.00488	-	-	-	-	.00389	.00191	-	.00774	.00652	-	-	-	.04819
26. Petroleum & Coal Products	.03275	.00923	.00585	.02795	.00594	-	.00008	-	.00049	-	-	-	.00296	.00174	.01430	-	.00206	.01133	-	.00016	.00010	.00083	.00038	-	-
27. Chemical Products	.02736	.02165	.00313	.00686	.00892	.00376	-	.00696	.00990	.01816	.00498	.00115	.00023	.00627	.21083	-	.00723	.05591	.00758	.03761	.00245	.00386	.01423	.02102	.00549
28. Rubber Products	.00053	-	.00054	.01152	.00185	-	-	-	-	-	-	-	-	-	-	-	.00207	.00015	-	-	-	.00633	.00086	.01818	-
29. Miscellaneous Manufacturing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00136	.00048	-	-	.00063	-	-	.01274	-
30. Utilities	.00858	.00718	.00568	.02419	.00639	.00330	.00744	.01341	.00618	.00727	.00555	.00927	.01766	.01615	.00979	.00190	.01136	.03462	.00458	.02617	.00450	.00854	.00741	.00890	.02835
31. Transportation	.11859	.12077	.06274	.26321	.13379	.03689	.11432	.05433	.08056	.16125	.31409	.07630	.08412	.01268	.06600	.00721	.10033	.05547	.01864	.08390	.06820	.05463	.00940	.01608	.18181
32. Services	.02113	.00487	.01131	.04799	.03024	.00206	.00543	.02190	.01348	.09039	.01077	.02327	.01250	.01936	.01616	.04891	.02895	.00507	.03670	.01579	.03065	.01515	.00122	.01187	.01125
33. Communications	.00128	.00624	.00114	.00167	.00071	.00157	.00222	.01562	.00604	.00392	.00506	.00667	.01228	.00454	.01596	.00852	.00256	.00713	.06415	.00699	.00356	.00734	.00512	.01979	.00234
34. Unallocated	.12377	.27498	.01288	.03986	.13797	.02265	.03798	.01545	.02203	.01971	.19958	.11588	.10253	.13576	.09822	.17531	.06151	.18600	.10124	.21008	.16347	.03718	.09903	.24870	.03687
Construction	.01322	.02757	.01127	.00360	.02210	.00461	.00832	.08489	.01266	.03013	.00612	.00484	.00379	.00167	-	-	.00891	.00917	.00229	.01241	.01290	.02754	.00480	.01608	.00229
Capital Formation	.10446	.17533	.05763	.04803	.10015	.04861	.01900	.02003	.00955	.02918	.03629	.02837	.03243	.02283	.02262	.01246	.02921	.04886	.03172	.07298	.03637	.02754	.02082	.02708	.04197
Government	.09901	.12438	.06699	.05431	.11836	.00597	.01153	.01545	.01097	.01829	.06892	.38353	.04213	.03845	.01723	.00879	.02032	.04911	.01977	.02531	.02898	.03966	.04590	.03821	.02873
Households	.32258	.25218	.24970	.22966	.17533	.08386	.13440	.17365	.05120	.16404	.09999	.10538	.10996	.09178	.18322	.21353	.37233	.12584	.28610	.16675	.26060	.23100	.38844	.11254	.16100
Imports	.03995	-	.01128	.08244	.08475	.01621	.02635	.20526	.02203	.04300	.10529	.03742	.00068	.05847	.16667	.34079	.17152	.07442	.25753	.05302	.19089	.16930	.16724	.32760	.07223
Corporate Profit	-	-	-	.02888	.10148	.05175	.02078	.02547	.01689	.02578	.05049	.07633	.04039	.05119	.03329	.02373	.03753	.07452	.08529	.03973	.05805	.05343	.05141	.03067	.05123

R DOLLAR OF OUTPUT

																Fina	
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	Construction	Capital Formation
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.01554
-	-	-	-	-	-	-	-	-	-	-	-	-	.00013	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00245
-	.17295	.00006	-	.00003	-	.29456	.00124	.04957	.00212	-	-	.00120	-	-	-	.00597	-
-	-	-	-	-	-	-	.43938	.02598	-	-	.12280	-	-	-	-	.00369	-
-	-	-	-	-	-	-	-	-	-	-	-	.00026	.00017	-	.00148	-	(.00073)
-	-	-	-	-	-	-	-	-	-	-	-	.00006	-	-	.00049	-	.00035
-	-	-	-	-	-	-	-	-	-	-	-	-	.00013	-	.00038	-	.00049
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00010	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00012	-	.00012
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00015	-	.00004
-	-	-	-	-	-	-	-	-	-	-	-	.00025	-	-	-	-	.00023
-	-	-	-	-	-	-	-	-	-	-	-	-	.00011	-	-	-	.00340
-	-	-	-	-	-	-	-	.00050	-	-	-	.00019	.00003	-	-	-	.00159
-	-	.00016	-	.00006	-	.00064	-	.00289	.05310	-	-	-	.00055	-	-	.00018	.00017
-	-	-	-	-	-	-	-	-	-	-	-	-	.00017	-	-	-	.00039
-	.00005	.00468	.00156	.01855	-	.00818	-	.04002	-	-	.00185	.00701	.00349	.00358	-	.03033	(.00014)
1042	-	-	-	.00208	.00890	.01644	-	.01639	.00119	-	-	-	.00184	-	.00028	.01699	(.00060)
7332	-	.00161	-	-	-	-	.00067	.00193	-	-	.00185	.00776	.00558	.00929	.00446	.00067	.00027
-	.06682	.10460	.28002	.06446	.07210	-	-	-	-	-	-	.00950	-	-	.00027	.00903	.00782
0061	.00153	.02115	.03516	.09651	.00655	.00842	-	.00026	.00314	-	-	.00896	.00062	-	.00050	.03339	.00563
-	-	-	.00092	-	-	-	-	-	-	-	-	.01101	-	-	-	.00091	.00224
-	-	-	-	.00032	-	-	-	-	-	-	-	.00476	.00017	-	-	.00276	.00934
-	-	-	-	.00141	.00297	-	-	-	-	-	.00232	.00010	.00008	.00202	-	.00320	.00248
-	.00774	.00652	-	-	-	.04819	.00304	.00906	-	.00309	-	-	-	-	-	.07993	(.00056)
-	.00016	.00010	.00083	.00038	-	-	.00025	.00012	-	-	.00223	.08128	-	-	.00226	.01171	(.00040)
0758	.03761	.00245	.00386	.01423	.02102	.00549	.01581	.05718	.02875	.03667	.00111	.00936	-	-	.00249	.00618	(.00037)
-	-	-	.00633	.00086	.01818	-	-	-	.04792	-	-	.00175	-	-	-	.00211	.00029
-	-	.00063	-	-	.01274	-	-	.00050	.00212	.00811	-	-	-	-	.00024	.00063	.00008
0458	.02617	.00450	.00854	.00741	.00890	.02835	.01109	.04645	.01493	.00836	.04363	.00130	.02624	.00912	.01252	.00200	-
1864	.08390	.06820	.05463	.00940	.01608	.18181	.23893	.09893	.04775	.05662	.05202	.01183	.01088	.04487	.01043	.00830	-
3670	.01579	.03065	.01515	.00122	.01187	.01125	.01770	.02824	.03308	.05649	.03246	.04147	.11887	.01458	.07730	.03461	-
6415	.00699	.00356	.00734	.00512	.01979	.00234	.00613	.01027	.01060	.04066	.00417	.00577	.01882	.01399	.01207	.00183	-
0124	.21008	.16347	.03718	.09903	.24870	.03687	.02001	.23420	.13096	.44486	.05379	.16282	.17808	.15651	.06593	.04288	-
0229	.01241	.01290	.02754	.00480	.01608	.00229	.02279	.00610	.00721	.00450	.06212	.04052	.01555	.03242	.01011	.00095	.73673
3172	.07298	.03637	.02754	.02082	.02708	.04197	.03351	.03970	.03155	.02265	.10189	.15008	.08591	.08606	.05015	.07858	-
1977	.02531	.02898	.03966	.04590	.03821	.02873	.04717	.04872	.04351	.02831	.12766	.08105	.07065	.06942	.08152	.01643	-
8610	.16675	.26060	.23100	.38844	.11254	.16100	.04910	.13653	.13299	.21130	.17039	.24632	.40034	.47206	.60108	.31666	-
5753	.05302	.19089	.16930	.16724	.32760	.07223	.06903	.08194	.38109	.02921	.00696	.03785	.01660	.01457	.00554	.22394	.21314
8529	.03973	.05805	.05343	.05141	.03067	.05123	.02414	.06242	.02799	.04916	.21272	.07754	.04358	.07327	.60182	.06613	-

TABLE XXXII

DISTRIBUTION OF OUTPUT OF EACH INDUSTRY
PER DOLLAR OF OUTPUT OF THE INDUSTRY, ALBERTA, 1962

	Industry Purchasing																								
Industry Producing	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Field Crops	.04477	-	.16097	-	-	-	-	-	.07456	-	-	.00500	-	.01373	-	-	-	-	-	-	-	-	-	-	-
2. Vegetables & Fruit	-	.00477	-	-	-	.00372	-	.06641	-	-	-	-	.35769	.00262	-	-	-	-	-	-	-	-	-	-	-
3. Livestock & Animal Products	-	-	.24636	-	-	.44909	.11248	-	.00046	-	-	-	-	.00008	-	-	-	-	-	-	-	-	-	-	-
4. Mineral Products	-		-	-	.01155	.04823	.00293	-	.00014	.00033	-	.00033	.00235	.00005	-	-	-	.00925	-	.10060	.00005	-	.00001	-	.32983
5. Petroleum	-	-	-	-	.01966	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6. Meat Products	-	-	-	-	-	.02924	-	.00009	.00534	-	-	-	-	-	.00240	-	-	-	-	-	-	-	-	-	-
7. Processed Dairy Products	-	-	-	-	-	.00252	.03024	.00010	-	-	-	-	-	.00062	-	-	.00079	-	-	-	-	-	-	-	-
8. Fruit & Veg. Prep.	-	-	-	-	-	-	-	.00170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9. Grain Mill Products	.17546	.00195	.20266	-	-	.00035	-	.00004	.00019	.16617	-	-	-	.01144	-	-	-	-	-	-	-	-	-	-	-
10. Bakery Products	-	-	-	-	-	-	-	-	-	.00043	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11. Carbonated Beverages	-	-	-	-	-	-	-	-	-	-	.00081	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12. Alcoholic Beverages	-	-	-	-	-	-	-	-	-	-	-	.00093	-	-	-	-	-	-	-	-	-	-	-	-	-
13. Confectionary & Sugar Refining	-	-	-	-	-	.00970	.01970	.00159	-	-	.04001	.00493	.00076	.00970	-	-	-	-	-	-	-	-	-	-	-
14. Miscellaneous Food Products	-	-	-	-	-	.06207	.00334	.00247	-	-	.01602	.00093	.00100	.04859	.00087	-	-	.00234	-	-	-	-	-	-	-
15. Leather & Textile Products	-	-	-	.00020	-	-	-	-	.05121	-	-	-	-	-	.08686	.22855	-	.06884	-	-	.00010	-	.00020	-	.0053
16. Clothing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00066	.09205	-	-	-	-	-	-	-	-
17. Forestry & Wood Products	.05011	-	.01856	.00645	.02309	-	.01105	-	-	-	-	.00049	-	-	-	-	.11287	.07310	-	.00002	.00323	.00019	.00646	-	.0077
18. Paper Products	-	-	-	.01095	.00514	.08134	.01910	.00428	.01652	.01006	-	.01764	-	-	.00005	-	.00262	.05064	.00868	-	-	-	.00165	.00183	.0357
19. Printing & Publishing	.00061	-	.00037	.00073	.00425	.00293	.00196	.00293	.00458	.00306	.00306	.00183	.00214	.00214	-	.00458	-	.00611	.07334	-	.00306	-	-	-	-
20. Primary Metals	-	-	-	.01399	.03337	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.06682	.14631	.06881	.04546	.01315	-
21. Metal Fabricating	-	-	-	.00402	.24103	-	-	.00482	-	-	.00197	.00208	.00010	-	.00002	-	.01244	.00027	.00032	.00110	.02115	.00618	.04866	.00085	.0115
22. Machinery Industries	.12853	.01102	.04591	.00193	.06004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00092	-	-	-
23. Transportation Equipment	.10240	.01036	.02348	.04961	.15313	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00032	-	-
24. Electrical Products	-	-	-	.00680	.08756	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00544	.00297	-
25. Non-Metallic Mineral Products	.01758	-	.01149	.03222	.02172	-	-	.00125	-	-	.00163	.00154	-	-	-	-	.00409	.00088	-	.00402	.00473	-	-	-	.0481
26. Petroleum & Coal Products	.10467	.00120	.01411	.01450	.02356	-	.00004	-	.00017	-	-	-	.00027	.00013	.00099	-	.00126	.00303	-	.00005	.00004	.00006	.00008	-	-
27. Chemical Products	.16482	.05301	.01425	.00671	.06673	.01148	-	.00053	.00652	.00542	.00078	.00040	.00004	.00121	.02764	-	.00833	.02819	.00318	.02140	.00195	.00054	.00571	.00218	.0060
28. Rubber Products	.02120	-	.01612	.07447	.09135	-	-	-	-	-	-	-	-	-	-	-	.01578	.00051	-	-	-	.00585	.00229	.01247	-
29. Miscellaneous Manufacturing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.01570	.00244	-	-	.00502	-	-	.01325	-
30. Utilities	.03733	.00127	.01868	.01709	.03451	.00728	.00409	.00073	.00294	.00157	.00063	.00231	.00216	.00224	.00093	.00027	.00946	.01261	.00139	.01076	.00259	.00086	.00223	.00067	.0224
31. Transportation	.13931	.00577	.05565	.05020	.19509	.02196	.02064	.00080	.01035	.00938	.00964	.00513	.00278	.00048	.00169	.00028	.02255	.00545	.00153	.00931	.01058	.00149	.00074	.00033	.0388
32. Services	.01383	.00010	.00559	.00510	.02456	.00068	.00055	.00018	.00096	.00293	.00018	.00087	.00023	.00040	.00023	.00104	.00363	.00028	.00167	.00098	.00265	.00023	.00005	.00013	.0013
33. Communications	.00677	.00134	.00452	.00142	.00463	.00418	.00179	.00103	.00348	.00102	.00070	.00201	.00182	.00076	.00183	.00146	.00258	.00314	.02356	.00348	.00247	.00090	.00179	.00179	.0022
34. Unallocated	.05508	.00497	.00433	.00288	.07716	.00511	.00260	.00009	.000107	.00043	.00232	.00295	.00128	.00193	.00095	.00254	.00524	.00693	.00314	.00883	.00961	.00038	.00294	.00191	.0020
Construction	.00756	.00064	.00487	.00033	.01570	.00134	.00073	.00061	.00079	.00085	.00009	.00016	.00006	.00003	-	-	.00098	.00044	.00009	.00067	.00098	.00037	.00018	.00016	.0002
Capital Formation	.09605	.00654	.03993	.00716	.11405	.02260	.00268	.00023	.00096	.00133	.00088	.00149	.00084	.00067	.00045	.00023	.00513	.00375	.00203	.00632	.00441	.00059	.00120	.00043	.0070
Government	.07627	.00389	.03897	.00679	.11317	.00233	.00137	.00015	.00092	.00070	.00139	.01690	.00091	.00095	.00029	.00022	.00300	.00317	.00106	.00184	.00295	.00071	.00236	.00051	.0040
Households	.07375	.00234	.04311	.00852	.04976	.00972	.00472	.00050	.00128	.00186	.00060	.00138	.00071	.00067	.00091	.00159	.01629	.00241	.00456	.00360	.00787	.00123	.00591	.00044	.0066
Imports	.01671	-	.00356	.00560	.04399	.00343	.00169	.00108	.00101	.00089	.00115	.00090	.00001	.00078	.00152	.00463	.01372	.00260	.00751	.00209	.01054	.00164	.00466	.00236	.0054
Corporate Profit	-	-	-	.00672	.18047	.03757	.00458	.00046	.00265	.00183	.00189	.00626	.00163	.00234	.00104	.00111	.01029	.00893	.00852	.00538	.01099	.00178	.00491	.00076	.0134

USTRY
BERTA, 1962

															Final Demand		
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	Construction	Capital Formation	Government
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.02796	-
-	-	-	-	-	-	-	-	-	-	-	-	.00498	-	-	-	.00005	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00584	.00007
.10060	.00005	-	.00001	-	.32983	.00239	.05068	.00033	-	-	.00630	-	-	-	.06429	-	-
-	-	-	-	-	-	.11076	.00347	-	-	.02273	-	-	-	-	.00052	-	-
-	-	-	-	-	-	-	-	-	-	-	.00044	.00053	-	.00655	-	(.00260)	.00180
-	-	-	-	-	-	-	-	-	-	-	.00035	-	-	.00721	-	.00407	.00365
-	-	-	-	-	-	-	-	-	-	-	-	.01613	-	.06876	-	.06978	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00199	-	(.00006)	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00538	-	.00439	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	.01321	-	.00294	.01305
-	-	-	-	-	-	-	-	-	-	-	.00372	-	-	-	-	.00737	-
-	-	-	-	-	-	-	-	-	-	-	-	.00606	-	-	-	.21779	.00644
-	-	-	-	-	-	-	.00260	-	-	-	.00507	.00167	-	-	-	.08977	.01015
-	.00010	-	.00020	-	.00539	-	.02203	.06130	-	-	-	.03878	-	-	.01469	.01439	-
-	-	-	-	-	-	-	-	-	-	-	-	.00787	-	-	-	.02183	.06143
.00002	.00323	.00019	.00646	-	.00777	-	.03550	-	-	.00223	.03118	.02784	.00355	-	.27701	(.00136)	.05782
-	-	-	.00165	.00183	.03572	-	.03251	.00036	-	-	-	.03363	-	.00743	.03582	(.01281)	.05812
-	.00306	-	-	-	-	.00299	.00458	-	-	.00611	.09473	.12224	.01986	.14363	.01678	.00688	.17948
.06682	.14631	.06881	.04546	.01315	-	-	-	-	-	-	.08564	-	-	.00645	.16717	.14906	-
.00110	.02115	.00618	.04866	.00085	.01158	-	.00032	.00060	-	-	.05773	.00721	-	.00847	.44168	.07669	-
-	-	.00092	-	-	-	-	-	-	-	-	.40397	-	-	-	.06886	.17380	.10485
-	-	-	.00032	-	-	-	-	-	-	-	.06078	.00397	-	-	.07252	.25239	.12284
-	-	-	.00544	.00297	-	-	-	-	-	.03092	.00495	.00742	.02226	-	.32439	.25897	.08286
.00402	.00473	-	-	-	.04819	.00524	.00827	-	.00028	-	-	-	-	-	.76833	(.00558)	.04327
.00005	.00004	.00006	.00008	-	-	.00024	.00006	-	-	.00164	.22112	-	-	.01625	.06540	(.00231)	.05379
.02140	.00195	.00054	.00571	.00218	.00601	.02980	.05718	.00435	.00366	.00154	.04798	-	-	.03376	.06509	(.00403)	.00462
-	-	.00585	.00229	.01247	-	-	-	.04792	-	-	.05937	-	-	-	.14690	.02070	.02205
-	.00502	-	-	.01325	-	-	.00502	.00322	.00811	-	-	-	-	.03217	.06666	.00824	-
.01076	.00259	.00086	.00223	.00067	.02243	.01511	.03356	.00163	.00060	.04363	.00482	.17452	.00754	.12246	.01521	-	.05208
.00931	.01058	.00149	.00074	.00033	.03883	.08782	.01929	.00141	.00110	.01404	.01183	.01952	.01001	.02753	.01704	-	.05556
.00098	.00265	.00023	.00005	.00013	.00134	.00363	.00307	.00054	.00061	.00488	.02310	.11887	.00181	.11367	.03958	-	.07405
.00348	.00247	.00090	.00179	.00179	.00224	.01010	.00897	.00140	.00354	.00505	.02580	.15144	.01399	.14281	.01688	-	.03388
.00883	.00961	.00038	.00294	.00191	.00209	.00279	.01730	.00146	.00328	.00550	.06168	.12110	.01322	.06593	.03335	-	.12047
.00067	.00098	.00037	.00018	.00016	.00024	.00408	.00058	.00010	.00004	.00817	.01974	.01360	.00352	.01300	.00095	.75856	.13983
.00632	.00441	.00059	.00120	.00043	.00700	.00964	.00605	.00073	.00034	.02148	.11723	.12045	.01499	.14250	.12600	-	-
.00184	.00295	.00071	.00236	.00051	.00402	.01136	.00623	.00084	.00036	.02259	.05315	.07279	.01016	.10828	.02212	-	.00121
.00360	.00787	.00123	.00591	.00044	.00669	.00351	.00518	.00076	.00080	.00895	.04794	.13986	.02050	.30879	.12651	-	.08150
.00209	.01054	.00164	.00466	.00236	.00549	.00903	.00569	.00400	.00020	.00067	.01347	.01061	.00116	.00520	.16364	.16036	.07335
.00538	.01099	.00178	.00491	.00076	.01344	.01082	.01513	.00101	.00117	.07002	.07457	.11471	.01994	.19356	.16556	-	-

TABLE XXXIII

INTERINDUSTRY TRANSACTIONS, ALBERTA 1962

DIRECT AND INDIRECT REQUIREMENTS PER DOLLAR OF FINAL DEM

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
74	0.00408	0.32892	0.00015	0.00015	0.22904	0.18813	0.00526	0.73280	0.26926	0.01038	0.09331	0.00279	0.51161	0.00323	0.00061	0.00024	0.00076	0.00010	0.000
03	1.00483	0.00002	0.00003	0.00003	0.00065	0.00196	0.21845	0.00005	0.00005	0.02261	0.00129	0.52005	0.00825	0.00007	0.00004	0.00003	0.00005	0.00003	0.000
95	0.00079	1.32836	0.00036	0.00042	0.91638	0.75712	0.00471	0.02778	0.01044	0.00080	0.00041	0.00069	0.00708	0.00634	0.00134	0.00082	0.00076	0.00028	0.000
35	0.00299	0.00364	1.02802	0.01048	0.00439	0.00324	0.01127	0.00525	0.00460	0.00387	0.00434	0.01615	0.00326	0.01530	0.00248	0.00304	0.02519	0.00103	0.196
62	0.03022	0.02648	0.04614	1.04603	0.02654	0.03284	0.02172	0.04357	0.04918	0.04953	0.01674	0.02906	0.02469	0.12919	0.02175	0.02162	0.04706	0.00859	0.043
38	0.00071	0.00138	0.00032	0.00037	1.03116	0.00096	0.00417	0.02631	0.00988	0.00062	0.00036	0.00062	0.00185	0.00700	0.00140	0.00025	0.00061	0.00025	0.000
12	0.00019	0.00007	0.00010	0.00012	0.00091	1.03129	0.00134	0.00014	0.00012	0.00025	0.00011	0.00018	0.00343	0.00016	0.00013	0.00080	0.00029	0.00008	0.000
08	0.00014	0.00005	0.00007	0.00009	0.00005	0.00006	1.00176	0.00008	0.00008	0.00013	0.00007	0.00013	0.00013	0.00010	0.00010	0.00005	0.00012	0.00007	0.000
44	0.00542	0.04533	0.00004	0.00005	0.03157	0.02625	0.00167	1.01511	0.37286	0.00120	0.00186	0.00290	0.05131	0.00042	0.00011	0.00005	0.00012	0.00003	0.000
03	0.00004	0.00001	0.00002	0.00003	0.00002	0.00002	0.00002	0.00003	1.00045	0.00004	0.00002	0.00004	0.00004	0.00003	0.00003	0.00002	0.00004	0.00002	0.000
03	0.00005	0.00002	0.00002	0.00003	0.00002	0.00002	0.00002	0.00003	0.00003	1.00087	0.00003	0.00005	0.00005	0.00004	0.00004	0.00002	0.00004	0.00002	0.000
04	0.00004	0.00004	0.00008	0.00004	0.00004	0.00005	0.00003	0.00005	0.00006	0.00009	1.00096	0.00004	0.00003	0.00003	0.00001	0.00003	0.00003	0.00001	0.000
01	0.00001	0.00001	0.00001	0.00001	0.00060	0.00373	0.00365	0.00003	0.00002	0.04332	0.00244	1.00078	0.00901	0.00004	0.00002	0.00001	0.00002	0.00001	0.000
06	0.00005	0.00005	0.00009	0.00005	0.00430	0.00082	0.00670	0.00022	0.00015	0.02072	0.00061	0.00125	1.05113	0.00335	0.00052	0.00005	0.00112	0.00003	0.000
61	0.00023	0.00074	0.00112	0.00028	0.00084	0.00074	0.00079	0.01189	0.00493	0.00017	0.00068	0.00018	0.00079	1.09614	0.16790	0.00324	0.02156	0.00033	0.000
25	0.00006	0.00022	0.00025	0.00012	0.00021	0.00043	0.00015	0.00025	0.00022	0.00008	0.00016	0.00006	0.00015	0.00024	1.00072	0.01769	0.00320	0.00007	0.000
26	0.00341	0.01337	0.01490	0.00689	0.01279	0.02719	0.00877	0.01510	0.01232	0.00431	0.00979	0.00319	0.00859	0.01455	0.00282	1.12970	0.20385	0.00365	0.000
29	0.00087	0.00125	0.00744	0.00101	0.01562	0.01221	0.03131	0.01502	0.02424	0.00071	0.02773	0.00080	0.00165	0.00512	0.00115	0.00189	1.05518	0.01224	0.00
92	0.00343	0.00241	0.00449	0.00319	0.00292	0.00416	0.02022	0.00668	0.01012	0.01430	0.00484	0.00945	0.00871	0.00367	0.01288	0.00240	0.00897	1.08135	0.00
27	0.00581	0.00375	0.01626	0.00904	0.00335	0.00427	0.00855	0.00457	0.00467	0.00696	0.00250	0.00484	0.00266	0.00316	0.00077	0.00327	0.00269	0.00068	1.07
71	0.00444	0.00306	0.01054	0.02948	0.00287	0.00378	0.05451	0.00415	0.00445	0.01538	0.00679	0.00431	0.00247	0.00539	0.00118	0.01196	0.00506	0.00139	0.00
95	0.00797	0.00451	0.00378	0.00293	0.00363	0.00405	0.00264	0.00453	0.00370	0.00410	0.00146	0.00523	0.00277	0.00168	0.00040	0.00145	0.00135	0.00036	0.00
13	0.01788	0.00580	0.02247	0.00184	0.00429	0.00401	0.00454	0.00619	0.00324	0.00226	0.00127	0.01004	0.00424	0.00112	0.00025	0.00071	0.00112	0.00019	0.00
13	0.00015	0.00011	0.00097	0.00136	0.00011	0.00014	0.00016	0.00017	0.00019	0.00017	0.00010	0.00020	0.00016	0.00032	0.00010	0.00010	0.00024	0.00019	0.00
47	0.00066	0.00558	0.03972	0.00439	0.00408	0.00348	0.02040	0.00357	0.00191	0.00216	0.00595	0.00104	0.00236	0.00365	0.00059	0.00508	0.00489	0.00023	0.01
62	0.02228	0.03119	0.05496	0.02001	0.02562	0.02906	0.01242	0.04259	0.03111	0.03047	0.01261	0.02341	0.02834	0.02893	0.00595	0.01345	0.02396	0.00314	0.02
04	0.02703	0.01772	0.01490	0.01327	0.01820	0.01311	0.01763	0.03995	0.03813	0.01227	0.00802	0.01630	0.02591	0.24981	0.03914	0.01197	0.07232	0.01044	0.04
08	0.00044	0.00137	0.01320	0.00251	0.00108	0.00113	0.00044	0.00102	0.00084	0.00084	0.00037	0.00063	0.00061	0.00074	0.00015	0.00279	0.00124	0.00010	0.00
09	0.00011	0.00006	0.00011	0.00011	0.00007	0.00009	0.00011	0.00010	0.00010	0.00010	0.00008	0.00010	0.00011	0.00022	0.00009	0.00160	0.00090	0.00006	0.00
32	0.01609	0.01622	0.03511	0.01365	0.01684	0.02043	0.02360	0.02231	0.02332	0.01570	0.01688	0.03079	0.03185	0.03110	0.01182	0.01837	0.05147	0.01079	0.04
93	0.14448	0.14772	0.31228	0.15936	0.14657	0.21503	0.11021	0.20470	0.25602	0.35131	0.10482	0.17355	0.10425	0.13736	0.03355	0.12918	0.11664	0.03123	0.17
92	0.04675	0.04625	0.09035	0.06528	0.04156	0.04838	0.05161	0.06688	0.14796	0.06352	0.05263	0.05860	0.07479	0.06450	0.08518	0.05830	0.05279	0.06247	0.07
09	0.01333	0.00617	0.00869	0.00630	0.00724	0.00858	0.02310	0.01386	0.01480	0.01466	0.01164	0.02310	0.01336	0.02622	0.01755	0.00719	0.01565	0.07389	0.01
40	0.34357	0.11053	0.14264	0.20594	0.11887	0.14171	0.14525	0.19654	0.16671	0.31892	0.17881	0.31828	0.32709	0.24161	0.24188	0.12301	0.28681	0.15161	0.31

eries to final demand by industry at left, total dollar production directly and indirectly required from industry at top.

TABLE XXXIII

INTERINDUSTRY TRANSACTIONS, ALBERTA 1962

DIRECT AND INDIRECT REQUIREMENTS PER DOLLAR OF FINAL DEMAND a/

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
.09331	0.00279	0.51161	0.00323	0.00061	0.00024	0.00076	0.00010	0.00022	0.00016	0.00012	0.00011	0.00020	0.00016	0.00011	0.00058	0.00031	0.00032	0.00006
.00129	0.52005	0.00825	0.00007	0.00004	0.00003	0.00005	0.00003	0.00004	0.00004	0.00003	0.00002	0.00004	0.00003	0.00002	0.00007	0.00003	0.00007	0.00002
.00041	0.00069	0.00708	0.00634	0.00134	0.00082	0.00076	0.00028	0.00061	0.00046	0.00032	0.00031	0.00060	0.00037	0.00024	0.00086	0.00072	0.00097	0.00017
.00434	0.01615	0.00326	0.01530	0.00248	0.00304	0.02519	0.00103	0.19647	0.02390	0.05658	0.01615	0.01630	0.32047	0.00482	0.06345	0.00586	0.00392	0.00052
.01674	0.02906	0.02469	0.12919	0.02175	0.02162	0.04706	0.00859	0.04326	0.01691	0.02311	0.01405	0.01926	0.04572	0.04206	0.50876	0.05926	0.02913	0.00877
.00036	0.00062	0.00185	0.00700	0.00140	0.00025	0.00061	0.00025	0.00055	0.00041	0.00029	0.00027	0.00053	0.00033	0.00022	0.00075	0.00072	0.00086	0.00015
.00011	0.00018	0.00343	0.00016	0.00013	0.00080	0.00029	0.00008	0.00018	0.00013	0.00009	0.00010	0.00017	0.00011	0.00007	0.00027	0.00011	0.00028	0.00005
.00007	0.00013	0.00013	0.00010	0.00010	0.00005	0.00012	0.00007	0.00013	0.00010	0.00007	0.00007	0.00013	0.00006	0.00004	0.00017	0.00009	0.00022	0.00004
.00186	0.00290	0.05131	0.00042	0.00011	0.00005	0.00012	0.00003	0.00007	0.00005	0.00004	0.00004	0.00007	0.00004	0.00003	0.00012	0.00007	0.00012	0.00002
.00002	0.00004	0.00004	0.00003	0.00003	0.00002	0.00004	0.00002	0.00004	0.00003	0.00002	0.00002	0.00004	0.00002	0.00001	0.00005	0.00003	0.00007	0.00001
.00003	0.00005	0.00005	0.00004	0.00004	0.00002	0.00004	0.00002	0.00005	0.00004	0.00002	0.00002	0.00005	0.00002	0.00001	0.00006	0.00003	0.00008	0.00001
.00096	0.00004	0.00003	0.00003	0.00001	0.00003	0.00003	0.00001	0.00004	0.00002	0.00003	0.00001	0.00001	0.00008	0.00007	0.00006	0.00003	0.00002	0.00002
.00244	1.00078	0.00901	0.00004	0.00002	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00000	0.00001	0.00001	0.00001	0.00002	0.00001	0.00002	0.00001
.00061	0.00125	1.05113	0.00335	0.00052	0.00005	0.00112	0.00003	0.00007	0.00003	0.00004	0.00003	0.00004	0.00010	0.00007	0.00065	0.00023	0.00005	0.00002
.00068	0.00018	0.00079	1.09614	0.16790	0.00324	0.02156	0.00033	0.00045	0.00033	0.00058	0.00036	0.00148	0.00158	0.00016	0.00416	0.06136	0.00027	0.00006
.00016	0.00006	0.00015	0.00024	1.00072	0.01769	0.00320	0.00007	0.00012	0.00013	0.00009	0.00037	0.00008	0.00033	0.00007	0.00092	0.00007	0.00008	0.00006
.00979	0.00319	0.00859	0.01455	0.00282	1.12970	0.20385	0.00365	0.00669	0.00750	0.00491	0.02362	0.00428	0.02046	0.00368	0.05746	0.00401	0.00375	0.00311
.02773	0.00080	0.00165	0.00512	0.00115	0.00189	1.05518	0.01224	0.00263	0.00075	0.00097	0.00285	0.01032	0.02088	0.00064	0.01987	0.00248	0.00131	0.00024
.00484	0.00945	0.00871	0.00367	0.01288	0.00240	0.00897	1.08135	0.00386	0.00436	0.00235	0.00165	0.00272	0.00419	0.00384	0.00747	0.00243	0.00466	0.00340
.00250	0.00484	0.00266	0.00316	0.00077	0.00327	0.00269	0.00068	1.07692	0.11650	0.30696	0.08122	0.07936	0.00949	0.00427	0.00742	0.00207	0.00166	0.00120
.00679	0.00431	0.00247	0.00539	0.00118	0.01196	0.00506	0.00139	0.00604	1.02369	0.03872	0.09996	0.00821	0.01551	0.00391	0.01721	0.00597	0.00205	0.00097
.00146	0.00523	0.00277	0.00168	0.00040	0.00145	0.00135	0.00036	0.00200	0.00113	1.00221	0.00045	0.00052	0.00354	0.00293	0.00304	0.00093	0.00093	0.00068
.00127	0.01004	0.00424	0.00112	0.00025	0.00071	0.00112	0.00019	0.00487	0.00099	0.00172	1.00085	0.00057	0.00804	0.00139	0.00279	0.00056	0.00052	0.00032
.00010	0.00020	0.00016	0.00032	0.00010	0.00010	0.00024	0.00019	0.00036	0.00011	0.00017	0.00151	1.00313	0.00046	0.00015	0.00091	0.00019	0.00021	0.00248
.00595	0.00104	0.00236	0.00365	0.00059	0.00508	0.00489	0.00023	0.01696	0.00908	0.00523	0.00232	0.00177	1.06350	0.00387	0.01486	0.00100	0.00400	0.00013
.01261	0.02341	0.02834	0.02893	0.00595	0.01345	0.02396	0.00314	0.02076	0.00963	0.01228	0.00462	0.00514	0.03506	1.02214	0.02451	0.00832	0.00820	0.00758
.00802	0.01630	0.02591	0.24981	0.03914	0.01197	0.07232	0.01044	0.04839	0.00979	0.01941	0.02032	0.02940	0.01555	0.02083	1.07298	0.04828	0.04225	0.00248
.00037	0.00063	0.00061	0.00074	0.00015	0.00279	0.00124	0.00010	0.00282	0.00053	0.00762	0.00128	0.01949	0.00462	0.00065	0.00233	1.05068	0.00027	0.00019
.00008	0.00010	0.00011	0.00022	0.00009	0.00160	0.00090	0.00006	0.00013	0.00073	0.00010	0.00017	0.01304	0.00011	0.00004	0.00076	0.00233	1.00834	0.00006
.01688	0.03079	0.03185	0.03110	0.01182	0.01837	0.05147	0.01079	0.04466	0.01500	0.02435	0.01551	0.02052	0.04687	0.01654	0.06878	0.02517	0.02247	1.04866
.10482	0.17355	0.10425	0.13736	0.03355	0.12918	0.11664	0.03123	0.17160	0.09988	0.11347	0.03918	0.004446	0.30833	0.26112	0.22195	0.07806	0.08136	0.06110
.05263	0.05860	0.07479	0.06450	0.08518	0.05830	0.05279	0.06247	0.07218	0.06735	0.04988	0.02639	0.05167	0.06512	0.04465	0.10975	0.06828	0.12025	0.04992
.01164	0.02310	0.01336	0.02622	0.01755	0.00719	0.01565	0.07389	0.01552	0.01002	0.01413	0.00948	0.02748	0.00929	0.01054	0.02178	0.01762	0.05188	0.00716
.17881	0.31828	0.32709	0.24161	0.24188	0.12301	0.28681	0.15161	0.31607	0.24137	0.15878	0.16389	0.32579	0.14726	0.09141	0.42167	0.20565	0.53342	0.08395

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